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THE FOOD PROBLEM OF INDIA*

ONE is at the very outset faced with several serious difficulties when enunciating the Food Problem of India. For a scientific appreciation of any phenomenon and for the formulation of a policy, certain fundamental data are essential; moreover such data must provide a realistic statistical expression of the material under study. For instance, to appreciate the food position of a country and to formulate a food policy for a nation, it is necessary that the data regarding the total requirements, available quantities of different categories of food and potentialities of increased production be ready to hand. In the case of India, lack of this precise information is the first difficulty. The importance of agricultural statistics was emphasized by the Indian Famine Commission of 1880, and since then the necessity of accurate statistics has been stressed by every committee and commission that has dealt with agricultural production. The Royal Commission on Agriculture in India recommended that the whole basis of statistics in India urgently required broadening, and laid emphasis on the fact that modern statistical methods were to make 'indispensable contribution to the successful development alike of agriculture and of social administration'. And yet, eighteen years afterwards, the Famine Inquiry Commission of 1945, recorded:

> "Problems arising out of the production and distribution of foodgrains during the war, have emphasized the need for accurate statistics of acreage and yield of crops; schemes, largely experimental in character, are now in operation with the object of securing improvements in these statistics."

Without an accurate and precise assessment of food requirements and agricultural production, no agricultural planning is possible. In countries where literacy is widespread the farmers themselves help to supply the required information, but in this country statistics of every type must be collected by a suitable agency, having adequate and well-trained staff.

It has to be recognised that to be useful an agricultural survey must be comprehensive, accurate, and quick, and it must at the same time be cheap. These opposing tendencies make the task difficult. There is evidently need for a carefully developed technique. Aerial survey for crop acreage should prove in the long run comprehensive, accurate, quick and cheap. The present is a suitable time for undertaking such an experiment, as trained personnel and up-to-date equipment are available, and the technique of aerial photography has greatly developed. To obtain figures of yield special equipment will have to be designed. It should be possible, for instance, to devise a harvester which will reap a narrow strip of wheat, thresh and clean it and give the weight of grain.

If it is proposed to plan on a sound basis then the development of the science of statistics must be an important item in the post-war programme. Ignoring this branch of science will mean building the post-war edifice of progress on a foundation of sand.

* Extracts from the General Presidential Address by Prof. M. Afzal Husain, M.A., M.Sc., F.N.I., to the Thirty-third Session of the Indian Science Congress, Bangalore, 1946.

The census returns for 1941, gave the population of India as 389 millions, an increase of 51 millions over the 1931 figures, or, an increase of 1·5 per cent. per year. It will not be incorrect to say that, at this rate of increase, India starts the year of grace 1946 with a population approximating to 415 millions. Even if there is no acceleration in this speed the population of India will exceed 500 millions before 1960.

From 1901 to 1940 the recorded birth-rate has shown a slight decline, but during the same period the death-rate has shown a marked fall. Ignoring the years of war as exceptional, the excess of births over deaths has been increasing steadily and for the decade 1931-1940 the excess of births over deaths was 11 per mille. If this tendency, whatever its causes might be, continues, the rate of increase of the population will be progressively faster. Hill estimates that the population will be 650 millions by 1970. This is by no means an over-estimate. In other words in twenty-five years we shall have 235 million extra mouths to feed. Past performances justify such an assumption. The country must be prepared to face this situation unless some calamity befalls us, reduces our population, and solves the problem for us.

Since 1911, 7 million acres have been added to the same area under cutlivation in British India, but in spite of this addition the area sown *per capita* has declined from 0·9 acre to 0·72 acre, *i.e.*, by 25 per cent. During the 30 years ending 1941, the area of and under irrigation increased by 14 million acres. If it be accepted that an irrigated area gives double the yield of an unirrigated area, then, in terms of unirrigated area, the total extension of cultivation may be computed at 21 million acres. On this basis the area sown *per capita* has decreased from 1·079 acres in 1911 to 0·916 acre in 1941, *i.e.*, by 18 per cent. Therefore, 18 per cent. increased production is necessary to maintain consumption *per capita* at the level of 1911. This increase could only be attained by the increased use of manures and fertilizers, extensive use of better varieties and increased application of methods to reduce wastage. It can hardly be denied that the use of manures and fertilizers has not increased and no large-scale measures to reduce wastage have been effected. The proportion of better-yielding varieties is indeed very low. It is a little over 22 per cent. in the case of wheat, 6·2 per cent. in the case of rice and 1·1 per cent. in the case of jowar. At a most liberal estimate all the improvements effected in the yield of cereal crops still leave a deficit of 15 per cent. in the quantities necessary to provide the same rations *per capita* as were available in 1911.

Reduction in the export of food grains and increase in imports of rice may together amount to a 5 per cent. increase in the available supply. Even then India is short of food grains by at least 10 per cent. *per capita* when compared with conditions which existed thirty-five years ago, and at that period food was by no means plenty, and famines were not unknown. There is thus not the slightest doubt that the food position has been deteriorating.

Let us compare our position with that of the United States of America, which shows a higher yield per acre of all crops when compared with India. Baker calculated that for a "liberal" diet containing meat, fruits and green vegetables in maximum quantities and a quart of milk per day, 3·1 acres of land were required *per capita*. For an "adequate" diet this area would vary from 1·8 acres to 2·3 acres *per capita*, according to the quantity of milk and other nutritious foods included in the diet. An "emergency restricted diet", which contained mainly cereals and was designed to tide over difficult times and short periods of privation, 1·2 acres *per capita* was the minimum required. Even this is 33 per cent. more than the area *per capita* available in India. This comparison is enough to show the low nutritional standard of the population in this country.

Deficiencies and their Consequences

It has been estimated that to feed a population of 400 million India needs an increase in cereals to the extent of 10 per cent., in pulses to the extent of 20 per cent., in fats and oils 250 per cent., in fruit 50 per cent., in vegetables 100 per cent., in milk 300 per cent., and in fish, flesh and eggs 300 per cent. These figures are staggering, because first of all these deficiencies have to be made up for the proper nutrition of the existing population, and a further increase has to be assured to meet the demands of the increasing population. For instance, to provide adequate nourishment for a population of 500 million in 1960, the production of cereals will have to be increased by 37·5 per cent., pulses by 50 per cent., fats and oils by 337·5 per cent., milk and fish, flesh and eggs by 400 per cent. With such deficiencies in food resources, it is not surprising that the Nutrition Advisory Committee have found from the results of actual "surveys of both typical urban and rural groups that the calorie intake of some 30 per cent. of families is below requirements and that even when the diet is adequate it is almost invariably unbalanced, containing a preponderance of cereals and insufficient protective foods of high nutritive value". There cannot be any disagreement on the point that "malnutrition promotes a state of ill-health and lower physical efficiency, short of actual disease; which are perhaps more important because more widespread than disease itself". Therefore, the Nutrition Advisory Committee correctly lays stress on the fact that "freedom from disease is one thing, abundant health is another" and "the goal to be aimed at is the creation of a healthy and vigorous population".

Solution of the Problem

The solution of the complex problem of providing adequate food for our population lies in the increase of the supply and, if possible, the decrease of demand.

On one extreme we have those who maintain that India is greatly over-populated and that her food resources have not kept pace with the rise of population and are progressively falling short of the minimum requirements and, therefore, "our present need is that the growth of population should be checked and even its decline welcomed!" They say: "Judged from any point of view a check on the growth of the population of India is an urgent

necessity" (Chand). There can be no doubt about the urgency of such an attempt as it would bring about a measure of relief and allow scope for adjustment. A stationary population for some years would avoid "futility and frustration" which the present situation strongly suggests. However desirable, a check on the growth of population may be, it is difficult to attain. Nevertheless, we may look at this problem from another point of view.

The United Nations have now accepted the responsibility for meeting the food requirements of all people. They must, therefore, determine the production of food and control its distribution. We are already hearing of world's wheat pools. The necessary corollary to this responsibility is that the United Nations will have to watch the population trend of various countries. What will be the attitude of the nations with a low or controlled birth-rate towards another nation with an uncontrolled and very high brith-rate? Will not the United Nations Organisation be justified in exercising some control over population? Having accepted membership of the community of nations, India will have to fall into line with the rest of the world. The solution of the population problem is not easy and at any rate it will be many years before a satisfactory solution can be found. In the meantime an increase in population will continue.

On the other hand there are those who firmly believe that "Nations can live at home" (Wilcox), and see in the development of the modern science of agrobiology the possibility of a manifold increase in the produce from land. They claim that the problem is not of *over-population* but of *under-development* of the natural resources and inadequate untilization of human knowledge to develop these resources. For instance, Wilcox places the theoretical limit of the yield of wheat at 171 bushels and of potatoes at 1,330 bushels, while the average in U.S.A. is only 8·4 per cent. of this 'penultimate' limit in the case of wheat and 8·6 in the case of potatoes.

Neither the policy of population reduction nor the magic wand of agrobiology can bring forth immediate results. The time factor is important. The Bengal Famine and insecurity of the food position are clear warnings. A sound policy would be to base our programme on the results previously achieved and attempt to evolve a scheme of increased food production from existing resources, leaving future enhancement of production for the increased population.

Unfortunately, determining food requirements by calories has produced an attitude more in favour of quantity than quality, and this has made it difficult to arrive at a scientifically correct food policy. Cereals have assumed unnecessary importance at the expense of "protective" foods. All those who have studied the food problem of India have emphasized this point. Colonel Macay held that with a low protein consumption deficiency in stamina, moral and physical, must be expected. According to John Russell the well-balanced diet for India "does not require more but less cereal than at present, but it includes more of everything else, especially vegetables, fruit and milk, and one great need for the food supply is to increase the production of these three". He advocated an increase in the yield of staple crops so as to liberate land for the cultivation of supplementary foods. India's ill-balanced diet, which has led to extensive malnutrition, is a far more serious national problem than any mere deficiency in the quantity of food. The population is degenerating in physique and in stamina. How else can one explain the curious phenomenon that lakhs died in Bengal without attempting to obtain food by fighting for it! To arrive at a correct appreciation of the food situation, it is necessary to deal with the various constituents of the diets, and not talk of calories, however convenient the slogan may be.

Let us shake off the cereal mentality and the talk of carbohydrates, fats, proteins, minerals, vitamins and so on, and make an attempt to evolve a scheme of a 'balanced diet' containing as far as possible all the ingredients in their correct proportions.

Requirements of Carbohydrates

The present position is that over 72 per cent. of the carbohydrates of human food are derived from cereals, about 20 per cent. from sugarcane, and the balance mainly from pulses. India, with 90 per cent. of her cultivated area under food-crops and 64 per cent. under cereals, is short of rice and is barely self-sufficient in other cereals. In spite of an intensive "Grow More Food" campaign, increased production has not kept pace with increased demand, and India is seeking imports at least at the pre-war level. It does not seem likely that India will obtain rapidly enough such a phenomenal rise in her soil fertility, such colonization of vast tracts of land, such rapid extension of irrigation, as to make up the existing deficiencies and provide for the future population, from a cropping scheme built round 64 per cent. area under

Cereals

In the circumstances India must produce, per acre, quantities of carbohydrates much in excess of what cereals can possibly yield. Because, if the required quantities of fuel foods can be produced from a smaller area, it would be possible to release land for the increased production of pulses, fats and oils, and "protective" foods of vegetable and animal origin, in which India is greatly in deficit. Tubers will satisfy this requirement.

In all countries where the population has increased, cereals have been increasingly replaced by tubers. For instance, in Germany, area under potatoes is 25 per cent. of that under all cereals. In England, it is 17·8 per cent. Even U.S.S.R. has 17·6 million acres under potatoes. In Java, one of the most thickly populated parts of the globe there has been, since 1916, a great increase in the cultivation of cassava and sweet-potato In many countries of Europe potato shares with cereals, more or less, on a basis of equality, in the carbohydrate supply of the human diet. Even in the United States, in spite of the availability of land, the ratio of cereals and potatoes in the diet of a household of the lowest income is 79·8 to 64·4.

Food Value of Tubers

As regards their food value: reduced to the same standard of moisture, tubers are richer in carbohydrates, mineral matter and calcium than cereals; they are, however, poorer in pro-

teins and deficient in fats. The great advantage of tubers over cereals is the yield per acre. If the average yield of rice and wheat in India be taken as 10 maunds per acre (although it is less), and the average yield of potatoes be taken as 75 maunds per acre (although it is more than 100 maunds), the per acre yield of various constituents of food will be very much higher in the case of tubers, except fat in potato and protein in cassava.

With a reasonable standard of cultivation, a yield of 200 maunds per acre is not difficult to attain in the case of potato, sweet-potato and cassava. With this yield the potato will provide a quantity of carbohydrates at least four times that of wheat, and sweet-potatoes and cassava about five times.

The superiority of rice and wheat in contrast to tubers is their high protein content. There seems no reason why India should persist in obtaining her protein supply from cereals. She must obtain the various ingredients of diet food sources from which they can be produced most efficiently and economically. In other words carbohydrates must be obtained mainly from tubers and cereals, if possible in equal proportions; proteins from pulses and animal sources such as milk, fish, flesh and eggs; fats and oils from milk and oil seeds; minerals, vitamins and other ingredients from such sources as supply them most economically.

In addition to providing large supplies of carbohydrates, minerals, calcium and phosphorus per acre, tubers can be used as fodder for livestock, as a source of starch for food products, such as biscuits, and a raw product for the manufacture of dextrine, glucose and sizing for the textile industry. In these respects they outstrip cereals. From the agricultural point of view, they loosen the lower strata of soil and lead to soil improvement. Potatoes respond to better cultivation and provide increased occupation for the farmer. There are some varieties of tubers that yield two and three crops a year, in which case the yield per acre is exceedingly high.

The greatest obstacle in the extension of the area under potatoes in India is the nonavailability of sound, healthy seed in adequate quantities, at the right time and at a reasonable price. The crop grown in the plains gets diseased and, therefore, seed has to be brought from the hills or imported from abroad. Researches have shown that healthy seed can be produced in India, and according to Burns, "given disease-free seed-potatoes and suitable manuring, the production of potatoes on the existing acreage can be doubled". Steps have been taken by the Imperial Council of Agricultural Research for the production and distribution of healthy seed. There are vast areas which provide suitable soil and climatic conditions for potato cultivation and in many parts of India two crops can be raised in a year.

Sweet-Potato

If potato is the tuber of the cooler regions, sweet-potato may with greater justification claim to be the tuber of the warmer regions of the gobe. If potato is the tuber of the West, sweet-potato is the tuber of the East. "The Chinese cultivate sweet-potato on a very large scale, and it enters into their diet, in some parts even more than rice." During 1943 the U.S.A. had 900,000 acres under sweet-potatoes, mainly in the Southern States. Some varieties of sweet-potatoes are only three-month crops. Even two crops a year, each yielding 200 maunds of tubers, grown over a moderate area, would convert Bihar and Bengal from deficit to surplus provinces, not only for carbohydrates but by releasing area for fodder, which will also increase the supply of milk.

Sweet-potato has this advantage over potato that it can be grown from stem-cuttings and the seed problem, the greatest obstacle in the extension of area under potato, does not arise. Again its demands for soil, manure and irrigation are not exacting either.

Proposals

If India could grow cereals and tubers in the same proportion as the pre war Germany, *i.e.*, in the proportion of 4:1, India could supply in full her present requirements of carbohydrates from an acreage equal to 60 per cent. of what is under cereals now. Even if 10 per cent. of the acreage now under cereals be diverted to tubers, India's carbohydrate supply will be increased by 33 per cent. By following such a policy, land could be released for pulses, oil-seeds, fodders and a more balanced diet obtained.

The proposal I place before you is that, if the area under cereals is reduced from the present 64 per cent. of the total sown to 45 per cent. or so, and of the area thus released, 5 per cent. of the total sown be planted with tubers, and the acreage of pulses be increased by 20 per cent., the out-turn of carbohydrate will be much in excess of the present quantity. I have taken tubers as an instance of high-yielding crops. Equally satisfactory results can be obtained from plaintains, which yield over 200 maunds of fruit per acre, and produce as much carbohydrate as sweet-potato or cassava with 100 maunds to the acre. They are also decidedly richer in proteins. Another high-yielding crop is carrot, which has the added advantage of being a rich source of carotene.

Requirements of Fats and Oils

India's requirements of fats and oils have been placed at 250 per cent. in excess of the available supply. The area released from cereals could permit the acreage under edible oil-seeds being doubled. This would also double the quantity of concentrates for feeding milch-cattle, and if a reduction in the number of bullocks can be brought about simultaneously, as suggested later on, there will be a further improvement in the food resources of milch-cattle. The introduction of a Soya bean, a legume rich in oils, will greatly enhance the supply of edible oil. In planning the nutrition of the whole world, the advisability of exporting oil-seeds from a country grossly deficient in fats and oils, will, we hope, be determined by the FAO.

Protein Deficiency

Deficiency in total proteins, and more particularly in the proteins of high biological value, is India's most serious nutritional problem. This deficiency may not manifest itself in mortality and disease, but is evident in the slow rate of growth, reduced size of body, lack of efficiency and vitality. That this is actually the case is abundantly manifested by the con-

dition of both men and cattle. Dr. Burns has correlated the amount of food and body-weight in cattle of the different regions of India, and Radhakamal Mukherjee has made similar studies in human groups. It is apparent that where cattle are ill-fed and small in size, and milk production per head of human population is low, the human physique is poor. Average live-weight of cattle and man is fairly closely correlated.

Pulses and cereals are the chief source of vegetable proteins. Reduction in the area of cereals will reduce the quantity of proteins of this source slightly, but a 20 per cent. increase in pulses will make up the deficiency It is, however, the increase of proteins of high biological value, which is India's greatest need.

The Nutrition and Food Management Committee of the FAO have recognised that "the primary objective of the nations united in the Food and Agriculture Organization is to raise the level of nutrition throughout the world, to ensure not only that all people are freed from the danger of starvation and famine, but that they obtain the kind of diet essential for health". Our Food Policy should aim at 'abundant health', and our goal should be 'the creation of healthy and vigorous population', able to shoulder the burdens of peace and war.

PROTECTIVE FOODS

Let us now deal with the foods of animal origin "protective foods" and proteins of high biological value, provided by fish and flesh, eggs and milk. The requirements of these foods for 400 million human beings is estimated at 300 per cent. over and above the present supply.

The most important of the food resources of this category are fish. The extensive waters around the coast of India, vast estuarian areas, numerous rivers and canals, lakes and tanks provide almost unlimited possibilities for the production of fish. Fish may be described as the food ready-made for man to collect. The neglect to develop, nay even to control, the fisheries in India has been colossal. It is only under the stress of war-time food scarcity that the necessity of developing this valuable source of food has been recognised. It is encouraging to find that severeal Provinces and States as well as the Central Government have taken steps to develop the fishery resources of the country. Programmes of development include all aspects of the fish industry, and teaching and research. We can look forward with confidence to the full development of this source of food. An abundant and cheap supply of fish will solve the problem of a balanced diet for the enormous rice-eating population No effort should be spared to develop fisheries.

Sheep, goats, pigs and poultry are well-known sources of food. The Imperial Council of Agricultural Research are financing research on these animals, with a view to improve breeds and increase the quantity of food produced from these sources. Among the smaller animals, a useful source of wholesome flesh is the rabbit. It multiplies very rapidly and grows quickly. In other countries rabbit-breeding is an important industry, and it is a pity that in India nothing has been attempted so far, and this excellent source of very good food is being ignored.

Investigations carried out in America indicate the importance of wild life. It has been shown that where marshes have been leclaimed for cultivation, the benefit gained has not compensated for the loss sustained, through the destruction of water-fowl. We have approximately 200,000 square miles of forests. Can they not be stocked with eatable birds? There is immediate need for a thorough survey and population study of the wild life of Idina as a preliminary to a national planning of game improvement.

THE CATTLE PROBLEM

Of the livestock the most important are the cattle and they occupy a unique position in the rural economy of India. They provide the draught animal for cultivation, contribute to the fertility of soil by providing farmyard manure—the only manure readily available to the farmer. Cattle dung makes up for the deficiency of fuel resources for household needs. Cows and buffaloes provide milk—a perfect food—and in a country where a large section of the population is vegetarian, the milk supply is of great importance. The cattle, finally, provide flesh for human consumption and their hides, bones and horns are products of considerable value in industry. Indeed the place of cattle in the economy of Indian farming is so fundamental that the ancients considered that the bull carried the earth on its horn, and they deified the cow. Paradoxical though it may appear, yet it is a fact that a stage has been reached when on the one hand cattle provide food for man and on the other compete with him for food. It is true that cattle mostly live on straw and stalk—bye-products of grain production—yet the pressure of population has forced man to encroach upon pastures and break land for the cultivation of food-crops with loss of fodder for cattle. The result is that to-day there is great scarcity of cattle feed. Cattle are underfed, inefficient, and too large a number has to be maintained. India possesses one-third of the world's cattle population. Without adequate feeding, improvement in breeds is a hopeless task.

Burns estimates that the total number of bouvine adults in British India is 107 million and the total feed available is 175 million tons of roughages and less than 4 million tons of concentrates. Ignoring the requirements of young stock, the deficiencies are: 50 million tons of roughages and 9 million tons of concentrates. Of the available food, work-cattle get the larger share, and milch-cows are starved.

In 1940, there were in British India 49 million working bullocks and uncastrated males over three years of age, kept for work. All those who have studied the food and agricultural problem of India have advocated the urgent need of reducing the number of bullocks, so that the cows are better fed and the milk supply is thus increased. For instance, the Royal Commission on Agriculture in India emphasised the "necessity of attention on all matters that will tend to decrease the number of bullocks required for cultivation". Sir John Russell followed in the same strain and said, "If it were feasible, the best course would be a large reduction in numbers of animals so as to bring livestock population more into line

with the supplies of food, but this cannot be done rapidly. Some gradual reduction will no doubt come about by economic pressure as the grazing grounds become more closely scattered for cultivation, and as the castration of scrub bulls becomes more commonly practised. Improvements in farm implements and particularly in the bullock-cart, would reduce the need for so many bullocks in the village".

Improvement of farm implements, or bullock carts with ball-bearings and pneumatic tyres, do not even scratch the surface of the problem. Co-operative use of inefficient bullocks is not a practical proposition when, on account of the shortness of season for the preparation of land, the available period for cultivation is limited. Small holdings will continue as long as there is no outlet for the rural population in industry. Utilising animal labour for cultivation and transport is a most wasteful method. It has been estimated that in many parts of India the work-cattle are employed for half the year, and yet they have to be maintained and fed throughout the twelve months. The Royal Commission have stated that bullock labour is a heavy item in crop production.

The *only* effective measure that will reduce the number of work-cattle is mechanization. Here is a pciture of a fully mechanized cotton farm in the U.S.A. "Tract-drawn equipment plants and cultivates the crop. Flame throwers kill the weeds. Airplanes dust the cotton with insecticides and, a week before the cotton is mature, they apply a cyanamide compound which makes the leaves drop off. When the leaves are gone, the cotton picking machine moves in. A cotton picking machine can pick a thousand pounds of cotton per hour, instead of 15 pounds a man can pick. Such a machine works all day and then with headlight on it works all night."

At the present time the aim in India should be to replace animal labour by machine and thus save food which is now consumed by the work-bullocks. What would be achieved as a result of such mechanization may be illustrated by taking an example from the U.S.A. "About 1920 there were 26 million horses and mules in the United States of America and by 1940 there were less than 16 millions. In 1919, there were 160,000 tractors, and by 1939, they had increased to 1,600,000. This has meant a release of 35 million acres of land the production of which was required to support work-stock." Imagine what similar reducion in the number of bullocks would mean to the human population of India. The fodder thus saved and fed to cows would bring about an immediate increase in the milk supply. Do we not know that a 60 per cent. increase in milk yield can be obtained by good feeding? Further with an assured supply of fodder the breeds can be improved, resulting in increased effi-ciency of milch cattle.

One of the post-war development plans is to take motor transport right into the heart of rural India; this will mean the replacement of bullocks now used for transport. There are schemes of hydro-electric development which will provide motive power for water-lifting, cane-crushing, corn-grinding, for which bullocks power is being used at present. A very real step towards the reduction of the number of bullocks will be the introduction of tractors.

The present is the most appropriate time for launching a campaign for the mechanization of agriculture. The price of bullocks is high. There are thousands of trained mechanics, familiar with tractors and other power-driven machinery, who will be released from the army. The chief difficulty, however, is that tractors are not available, and designs suited to Indian conditions have not been determined.

In my opinion the first step that should be taken is to hold an exhibition of tractors and farm machinery on a very large scale, to which tractor manufacturers and producers of farm machinery should be invited from all over the world. This would enable agricultural experts and manufacturers to determine which models are most suited to conditions obtaining in India. The next step would be to establish a tractor manufacturing industry and a fully-equipped Institute for Research on Tractor Designs to guide such an industry. The first need of India is is not luxury motor cars but sturdy tractors, of moderate size and moderate prize, which run on cheap fuel.

Increased Production of Vegetables and Fruit

The consideration of increased production of vegetables and fruit need not delay us too long. By proper management, use of good seed, and plants of high-yielding varieties, production of these useful and necessary foods can be greatly enhanced from the existing area. A system of cropping in which orchards are intercropped with fodder or vegetables, will mean better use of the land. For instance, fodder could be grown in a vineyard, an orange grove or a mango orchard. Carefully planned trials alone will determine the most rational use of land, as various conditions will determine what can be achieved, and these conditions vary from locality to locality.

Conclusion

To sum up: A national crop planning should be based on the best and most efficient utilisation of land and other resources for social needs. The first social need is food. It is possible to evolve, for the various parts of the country, cropping schemes which will result in greater production of carbohydrates from smaller areas, than is the case at present. In any such scheme tubers will play an important part, and the area under cereals will have to be reduced. Acreage released from cereals can be devoted to pulses, oil-seeds, fodders, an increased production of which is necessary for obtaining well-balanced diet. The increased food for milch-cattle, both in roughages and concentrates, which will result from such a cropping scheme, will make up our existing deficiencies in milk—a most necessary 'protective food'. The introduction of more legumes, *i.e.*, pulses as well as fodders, will enrich our soils. A reduction in the number of bullocks by encouraging the use of tractors and motor transport, and the introduction of machinery driven by cheap electric power, will release much fodder and enable us to improve our breeds of milch-cattle, with a consequent increase in milk production.

All this is possible and we have the knowledge to do it, but as the Hot Springs Conference stated—'It requires imagination and firm will on the part of each government and people to make use of that knowledge".

ANNUAL SESSION OF THE INDIAN ACADEMY OF SCIENCES HELD AT UDAIPUR

THE Indian Academy of Sciences, Bangalore, held their Eleventh Annual Meeting jointly with that of the National Academy of Sciences in the historic city of Udaipur from the 26th to the 29th December 1945. The Session was inaugurated by a Message from His Highness the Maharana Sahib Bahadur of Udaipur.

The Presidential Address to the Indian Academy of Sciences was delivered by Sir C. V. Raman on "The Crystal Forms of Diamond and their Significance", which he illustrated by means of large-size wooden models of the crystals of diamond. Diamond is unique among crystals in that it really exhibits the usual external form of plane faces bounded by sharp edges, which is considered to be characteristic of all crystals. It is, therefore, incorrect to attempt to describe the crystal forms of diamond in terms of the usual nomenclature of geometrical crystallography, which makes use of the plane faces for this purpose. On the other hand, what is really characteristic of a crystal of diamond is the set of edges which form a network of intersecting lines on the curved surface. Sir C. V. Raman suggested that these edges are fundamentally related to the internal architecture of the crystal and that they invariably lie in a plane containing the valence-bonds within the crystal. There are six such planes, which cut the surface into 24 segments, and every diamond exhibits only 24 segments on its surface. The 48 segments which should be present if diamond possessed the holohedral symmetry of the cubic system are never found at all. On the basis of these ideas, it is also possible to explain the origin of some peculiar forms of diamond, as for example, the fact that flat triangular natural crystals are always twinned and so on.

The Presidential Address to the National Academy of Sciences was delivered by Professor K. S. Krishnan on "Electron-Scattering in Metals and Alloys in relation to their Electrical Resistivities". Prof. Krishnan explained how modern quantum mechanics have led to the postulation of electron waves within the lattice of a metal, and how the resistance of a metal or an alloy arises essentially from the scattering of these electron waves. He pointed out that the problem of evaluating the scattering coefficient for electron waves can be attacked from the same standpoint as that used in the scattering of light waves, namely, by making use of the theory of fluctuations due to Einstein and Smoluchouski. For pure metals, the fluctuations in density alone need be taken into account, while with alloys the fluctuations in the relative concentration of the components also come in, for which reason the resistivity of alloys is in general greater than that for pure metals. The calculations made on this basis agree well with the known data on the resistivity of metals and alloys.

A number of symposia were held on a variety of subjects of interest to physicists, chemists, geologists and agriculturists. One of the symposia on "The Age of the Saline Series in the Salt Range of the Punjab", convened and presided over by Prof. Birbal Sahni of the Lucknow University, lasted for one and a half days. A large number of official and non-official geologists and paleo-botanists took part in the discussion, and no less than fifteen papers were considered.

The problems of agriculture in India received much attention during the Session, and two symposia were exclusively devoted to this subject and were attended by officials and non-officials from various parts of India. The first symposium was on the "Role of Plant-breeding in the Development of Indian Agriculture". The principal speakers were Dr. Shri Ranjan of the Allahabad University and Mr. K. Ramiah, Plant-Breeding Expert at Indore. The theory and practice of plant-breeding were reviewed in the symposium with special reference to the need of the practical agriculturist in various parts of India. The importance of breeding for such special qualities such as disease resistance and draught resistance in addition to increased yield were stressed. Dr. Shri Ranjan exhibited a series of new wheats developed by him using the X-ray technique.

There was also a symposium on the very important subject of getting accurate "Statistics of Crop-Production in India". The need for reliable data regarding both food and money-crops can scarcely be overstressed. Dr. P. V. Sukhatme of the Imperial Council of Agricultural Research led the symposium with a brilliant exposition of the ideas and methods which he has developed for the purpose. These are strikingly different from those advocated by the Calcutta School of Statisticians. The results already obtained by the new method indicate that they are of great value and could be recommended for adoption everywhere in India. The above speaker was followed by a whole group of speakers who described the technique and their results for different crops.

There were also symposia on subjects of academic interest in physics and chemistry. Dr. S. V. Anantakrishnan of the Madras Christian College opened a symposium on the "Electronic Theory of Valency" in which he traced the development of the theory with particular reference to the more recent trends in the subject following the classical investigations of Heitler and London. A lively discussion followed in which numerous chemists and physicists took part.

A symposium was also held on the "Structure and Properties of Diamond" in which various properties of diamond such as its fluorescence, phosphorescence, absorption, magnetic rotatory power, thermal expansion and other properties were reviewed. A number of new results recently obtained in Sir C. V. Raman's laboratory were presented by his co-workers.

There were public lectures in the evenings on subjects of popular interest. Dewan Bahadur Dr. Ramanathan delivered an illuminating lecture on the services which a well-organised department of meteorology could render to the country and especially to the agriculturist,

Mr. E. R. Gee of the Geological Survey of India gave a highly interesting account of his travels in Afghanistan, illustrating his talk with the projection of a number of photographs taken by him of the country and of the people. Mr. Ramiah delivered a popular lecture on the subject of plant breeding. He emphasized the need for systematic researches on the genetics of plants indigenous to India. He suggested that the systematic use of hybrid seed which is now universal in U.S.A. for maize could prove most useful in those parts of India where the production of this crop is important.

Excursions were also arranged to visit some of the beauty spots in the city and places of interest in the neighbourhood.

SYMPOSIUM ON MINERAL RESEARCH IN INDIA

UNDER the auspices of the National Institute of Sciences of India, a Symposium on Mineral Research for Developing Mineral Industries in India was held at the Delhi University recently.

The Hon'ble Sir Ardeshir Dalal, Member for Planning and Development, Government of India, in inaugurating the Symposium, expressed the hope that the papers and discussions and the deliberations of scientists gathered at this meeting, would help the Planning Department in their post-war plans for exploring the mineral resources of India.

In his opening address, Mr. D. N. Wadia, President of the Institute, and Mineral Adviser, Planning and Development Department, Government of India, spoke on India's existing mineral resources, its chief assets and deficiencies, the neglect mineral industries have hitherto received in India, due to its economics being based on export of raw minerals rather than domestic utilisation and outlined a long-range national plan for minerals.

Twenty-five papers were presented for reading at the Symposium which lasted two days. A large number of Fellows and many distinguished scientists attended the meeting and took part in the discussions.

Messrs. A. O. Rankin, F.R.S., and P. Evans, in a paper on "Geo-physical prospecting for oil in India", referred in some detail to the history of gsophysical prospecting for petroleum in India with mention of scope and cost of the prospecting programmes outlined by the B.O.C. for future. In discussing the results, stress was laid on the necessity for a unified propecting programme in which geo-physical mapping, electrical and magnetic surveys of alluvial areas and the drilling and test-wells are all closely co-ordinated. Messrs. P. Evans and W J. Wilson read a paper on "The refining of petroleum in India and Burma". Mr. E. S. Pinfold, of the Attock Oil Company presented a paper on the "Scientific problems in the development of the oil-fields in Northwest India" and possibilities of oil exploration in that area.

Dr. J. de Graaff Hunter, F.R.S., and Brigadier E A. Glennie referred to the "Geo-physical applications of Geodesy".

Professor M. N. Saha, F.R.S., referred to his investigation on the "Measurement of geological time in India" by radio-active methods.

Mr. E. R. Gee dealt with the economic minerals of Northwest India, and Mr. B. Rama Rao dealt with the scope for expansion of non-metallic industries in South India.

Professor S. K. Roy gave the results of the survey of the Jawar lead-zinc deposits of the Mewar State.

Dr. J. A. Dunn presented two papers on the position of the Geological Survey of India and the development and future position of ores and minerals in India.

Dr. F. G. Percival gave a revised estimate of the reserves of iron-ore in the Singhbhum-Orissa field, as being much in excess of 8,000 million tons.

Dr. K. R. Krishnaswami spoke on mineral research at the Indian Institute of Science. Dr. Gilbert J. Fowler, in an interesting paper, described the production of Nitre from ammoniacal waste.

Dr. C. S. Pichamuthu of Bangalore emphasised the role of universities in mineral research. Prof. A. K. Ghosh, of the Calcutta University, referred to the possibilities of exploring diatomaceous earth in India. Dr. D. P. Antia gave an interesting paper on "Powder Metallurgy" and Dr. D. R. Malhotra on "Metallurgical research in India". Dr. A. Lahiri, of the Fuel Research Institute, gave a paper on "The trends of modern research on Coal".

Evening popular lectures were delivered on the occasion by Professor M. N. Saha, F.R.S., on his experiences of Soviet Russia, and by Professor H. J. Bhabha, F.R.S., on the role of mathematics in the evolution of science.

METALS IN AIRCRAFT*

THE metallic materials commonly used in the construction of aircraft were reviewed and attention drawn to the great diversity of the metals to be found in them. Steels of various compositions were dealt with and an explanation given of the advantages to be obtained by using alloy steel of the air-hardening type. Brief references were made to the different kinds of stainless steel and also to the processes of "case hardening" and "nitriding". The opportunity was then taken to give a simplified account of the changes which occur during the heat-treatment of steel. Mention was made of numerous alloys based on aluminium and magnesium and it was explained that the mechanism of hardening in these alloys was somewhat similar to that which took place in steels. Finally, a table was given showing the densities and maximum tensile strengths of cast iron, mild steel, an alloy steel, an aluminium and a magnesium alloy—all except the first being heat-treated so as to give good mechanical properties.

FRANK ADCOCK.

* Abstract of the Inaugural Address to the Society of Aeronautical Engineers, delivered by Prof. Adcock.

THE NUCLEOLUS

BY

B. R. SESHACHAR AND K. V. SRINATH

(University of Mysore, Central College, Bangalore)

WITH the re-orientation of our ideas regarding the structure and composition of the chromosomes, there has arisen a necessity for a re-examination of the various problems relating to the nucleolus, which has not received the same amount of attention. The chromosomes, whose composition until five years ago remained a mystery, are to-day known to be composed of nucleo-proteins. Evidence in support of this has been adduced in three different ways: (1) staining reactions with dye-stuffs, (2) digestion by proteases and nucleases, and (3) specific absorption of ultra-violet radiation. The chromosome is interpreted as having a protein framework built up of peptide linkages —Co-NH— and on this framework are fixed at intervals the active groups which we know as genes. The ease with which the nucleases attack the nucleic acids of the chromosomes suggests a loose binding between the protein and nucleic acid in these structures. The linkage is believed to be salt-like (polar) and it may be considered as arising largely from electrostatic forces of attraction between the positively charged groups on the protein and the negatively charged groups (phosphoric acid) on the nucleic acid. The nucleo-protein is thus a readily dissociable complex and its integrity is governed, among other things, by the pH of its medium and by the concentration and nature of the salts present. In the mitotic cell, nucleic acid is synthesized and degraded, and recent findings suggest that there is likewise a protein cycle. In cells where the content and character of nucleic acid and protein are subject to change, the nucleo-proteins are most likely to be of a relatively loosely bound and transitory nature. At the start of the mitotic cycle (prophase) there is an accumulation of nucleic acid in the chromosome which reaches a high value in metaphase and largely disappears at telophase. This nucleic acid is of the desoxyribose type, yielding a positive Feulgen reaction; in no place other than the chromosome and the fully formed sperm is this type of nucleic acid known to occur. At the end of mitosis, small nuclear organelles are formed, which are called nucleoli, and moreover, a residuum of nucleoprotein is observed at the site previously occupied by the metaphase chromosome. This residuum, together with the nucleoli in the resting nucleus, does not contain desoxyribose, but only ribose nucleic acid of the cytoplasm. It would appear, therefore, that although the greater part of the chromosome is composed of desoxyribose nucleic acid, a part is also composed of ribose nucleic acid. The particular regions on the chromosome associated with hereditary characteristics, the genes, have been located in positions in which only the nucleic acid of the desoxyribose type is present. The part of the chromosome which presumably persists into the resting stage of the nucleus and which contains nucleic acid of the ribose type has been presumed to be genetically inert and is referred to as heterochromatin. Caspersson and Schultz[1] suggest that the heterochromatin is responsible for the synthesis of the desoxyribose nucleic acid of the euchromatin. This suggestion was largely based on the remarkable finding that translocation of part of the heterochromatin to euchromatic segments results in an increase in the nucleic acid content of the latter in the immediate neighbourhood of the translocation, together with an instability of the neighbouring genes.

Parallel with the nucleic acid cycle in the nucleus runs a protein cycle. In prophase, as the content of desoxyribose nucleic acid begins to increase, the relatively large amount of the complex protein present begins to decrease and alter into protein of the simpler histone type. At telophase, the euchromatic elements of the chromosomes begin to lose the desoxyribose nucleic acid and simultaneously to alter their protein to the complex type, whereas the heterochromatic elements produce protein of the histone type. In the resting nucleus the heterochromatin and the nucleoli contain the histone type of protein and ribose nucleic acid. The distribution of the complex and simple types of proteins in the chromosome has been independently inferred by enzymatic experiments.

That, briefly, is the picture offered of the chromosomes based on recent work. The nucleolus on the other hand, has always been held to be of subsidiary importance and though a number of efforts have been made to regard this cell-organelle from the view-point of its immediate functional importance, its true nature, and more especially, the larger problem of its significance to cell-economy have not received the same care and attention that have been directed to the chromosomes. It must, however, be said that in plant cells, exhaustive inquiries have been made in regard to the relation between the nucleolus and the chromosomes, in recent years stress having been laid on the significance, number and size, and origin of the nucleolus. In animal material on the other hand, the nucleolus still remains an obscure and ill-defined body, which in some manner, is either responsible for the synthesis of certain metabolic nutrient substances, or contributes, in the same ill-understood way, to the formation of the chromosomes.

But mainly due to the large amount of attention directed towards it by Gates and his co-workers, certain important conclusions have emerged which may be summarised as follows: The nucleolus is present in a very large majority of plant and animal cells. It is denser than the rest of the nucleus and lies embedded in it. On account of this density it can be expelled from the nucleus on centrifuging.[2,3] While it appears to lie loose and free in the nucleus of the Echinoderm egg and is capable of being

moved inside it,[4] in the majority of plants that have been examined and in *Drosophila* and *Chironomus* it is in specific relation with a chromosome and arises next to a particular particle on it, the nucleolar organizer.[5,6] In primitive plants like *Spirogyra* and *Lomentaria*[8] a peculiar type of intra-nucleolar mitosis has been described, where the chromosomes having been formed in the karyolymph in the normal way, migrate into the large nucleolus and complete their separation there, —a very remarkable phenomenon. Quite another kind of interest is provided by the behaviour of the nucleolus in Selachian oogenesis where it has long been known[9] that as the germinal vesicle becomes developed, and synchronously with the obscuration of the chromosomes, the number of nucleoli in the nucleus increases till a very large number is found.

These and other facts regarding the number, size and behaviour of the nucleolar bodies made the problem so bewildering in its complexity that by 1925 it was believed that the astonishing variation exhibited by the nucleolus in its various aspects could only be explained by the greatly protean nature of this body, which, retaining in itself infinite potentialities, reacted differently in different environments.

But with the development of specific techniques for the detection of certain essential constituents of the nucleus it was possible to narrow down the definition of the term 'nucleolus' or analyse its chemical constituents so that it was possible to see if 'nucleolus' included in it one uniform type of body occurring throughout plants and animals or different types of structures. On this basis were eliminated the structures that were originally regarded as nucleoli but which on specific staining by Feulgen proved to be not. Thus the chromatoid body in the nucleolus in *Pentatoma* spermatogenesis[10] was proved not only not to contain any chromatin (as it was originally believed) but in fact was shown to play no part in spermatogenesis, being cast away at the end of the process as a useless structure. Because, on this basis whether the nucleolar body contained chromatin or not, the whole superstructure of the chromatin contribution of the nucleolus to the chromosomes stood or fell. As a result mainly of the appllication of Feulgen technique, it was now clear that the nucleolus did not contain chromatin. On this basis, therefore, all the old theories which regarded the nucleolus as a store-house of chromatin of as a manufacturer of chromatin were disregarded. The application of these methods to the developing egg-cells of insects[11] has shown that what were originally regarded as chromatin nucleoli on the basis of Heidenhain staining remain uncoloured by Feulgen, showing that there was no transfer of chromatin from nucleolus to the chromosomes. It is more than likely that a re-examination of Selachian oogenesis will prove the same thing.

Having disposed of one important question regarding the chromatin nature of the nucleolus it became possible to go further. An extension of the staining reactions in the form of the employment of light-green as a counterstain has been developed in Gates's laboratory[12,13,14] and an application of these methods has shown that a true nucleolus stains green. That light-green is specific for histones has been established by Metz[15] who made a histone preparation from sea-urchin sperm and found it staining intensely with green.

On the basis of this new staining method, Gates has been able to establish, mainly in plant material, the part the nucleolus plays in the mitotic cycle. "The nucleoli arise in telophase at a particular locus of the chromosomes, having a satellite or a secondary constriction. Each grows to a predetermined size and when any two nucleoli touch during this growth or through movements of the chromosomes within the nucleus, they merge, like two droplets into one. The process generally continues until before the following prophase a single large fusion nucleolus is present to which the chromosomes which produced the nucleoli will all be found attached at the loci of the origin of the original nucleoli. When the nuclear membrane breaks down in late prophase, the nucleolus generally becomes detached from the chromosomes and passes into the cytoplasm where it disappears."[5]

Far from the nucleolus contributing material to the chromosomes in the formation of the latter, it would appear that the nucleolus actually *receives* material from the chromosomes and transfers it back to the cytoplasm during every mitotic cycle. Staining reactions as well as examination by ultra-violet absorption spectroscopy, show that this material is not chromatin but is largely made up of protein with which nucleic acid of the ribose variety is often associated. Hence the confusion which was met with in the earlier stages of the history of our knowledge of the nucleolus. Hæmatoxylin is unable to differentiate between the two types of nucleic acid and the 'karyosomes' of Ogata[16] and the 'chromatin nucleolus' of Montgomery[17] must have been largely such accumulations of ribose nucleic acids in relation with protein. It is believed that in telophase, when the desoxyribose nucleic acid of the chromosomes is being reconverted into the ribose type, some of it, with the protein, must find its way into the nucleolus. In fact, it is assumed that to account for the growth of the nucleoli at the nucleolar organizers, "each acts as a sink or a sump at which the material aggregates". It is tempting to adopt the attractive hypothesis that in the transference of the nucleic acid from the nucleus to the cytoplasm the nucleolus plays an important part as a vehicle, receiving the excess protein and nucleic acid from the chromosomes and transferring it back to the cytoplasm during every mitosis,—a transference whose full significance is still obscure but which according to Gates, may be "a source of energy in the cell".

Whatever the functional significance of the nucleolus in the mitotic cycle, it is clear that it is a repository of simple types of proteins (histones) associated with ribose nucleic acid.

That is the picture so far as the majority of plants are concerned, where the relationship between the nucleolus and the chromosome has been established and where the part

played by the nucleolus in the protein and nucleic acid metabolism may be estimated with a reasonable amount of certainty. Unfortunately, however, in animal cells, this relationship between the chromosomes and the nucleolus has not been established with the same amount of unmistakable regularity. Only in the salivary gland nuclei of Diptera have the nucleoli an appreciably similar disposition. In *Chironomus*, where the nucleolus is extremely large, it is associated with the small chromosome IV.[18,19] It is important that in so far as animal cells are concerned, the nucleolus requires further study, not so much from its functional aspect, but from the aspect of its relation with the chromosomes.

The present position in regard to the nucleolus would be that it is largely composed of histone and ribose nucleic acid which it receives from the chromosomes during telophase and which later diffuses into the cytoplasm, where it stimulates the synthesis of proteins and other metabolic products. In fact, a definite connexion has been established between the size of the nucleolus and protein production, the nucleolus being largest in cells where rapid protein production is going on, and relatively small in cells where no protein is being made.[6]

In this connection, the study of the nucleolus of the Sertoli cells of the testis is full of interest. In his description of the cytology of the Sertoli cells in the testis of Apoda (Amphibia), one of us[20] noticed a number of nucleoli in the Sertoli nuclei, all taking up hæmatoxylin. Re-examination of these nucleoli and selective staining by Feulgen-light-green showed that the nucleolus (of *Siphonops annulatus*) was really a compound structure; the centre, a spherical body stained green, to the periphery of which were plastered a number of pink bodies. This picture of the nucleolus demanded a new orientation of our ideas of the nucleolus. Undoubtedly here we had a compound nucleolus with a central Feulgen negative sphere in which there was a preponderance of histone while the periphery was made up of a varying number of Feulgen positive bodies in which there was an accumulation of desoxyribose nucleic acid. The association of desoxyribose nucleic acid with histones in the nucleolus is an interesting discovery and is in our opinion, a visual demonstration of the truth of the association of the two components. Until now such an association between the desoxyribose nucleic acid and the histone in the chromosomes was only inferred by indirect methods such as have been recalled earlier. The fact of the association of the two demonstrated by staining technique adds precision to the picture.

It has, however, not been possible, in the Sertoli cells, to establish a connection between the nucleoli and the chromosomes. Sertoli cells are nutritive and supporting cells of the testis and mitoses in them are either rare or wanting. We have to regard them as cells which have attained a condition of permanent rest. Under the conditions, it is therefore impossible to establish a relationship between the chromosomes and the nucleoli. But the relatively large nucleolar content of Sertoli cells in the Apoda may be understood by the assumption of their importance in protein production but here we would like to be on surer ground before assuming the fundamentals of the behaviour of Sertoli cells. A systematic examination of different types of animal and plant cells is being made in these laboratories with a view to harmonizing our present divergent ideas regarding the origin and significance of nucleoli.

In this connexion, we would like to enter a strong plea for the provision in this country, of adequate equipment for modern methods of biological investigation. The wide possibilities opened up by ultra-violet absorption spectroscopy developed by Caspersson as long ago as 1934 or the immense advantages of the Electron microscope are denied to workers in India, and we would like to take this opportunity to urge on the premier Scientific Institutions and Societies, and the Governments in the country to make available these modern facilities for biological investigation.

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THE AGE OF MICROLITHIC CULTURE IN GUJARAT

BY H. D. SANKALIA

WHILE reviewing our work, "The Second Gujarat Prehistoric Expedition in Search of Microlithic Man in Gujarat", it was said in *Nature*[1] that the microlithic industries in India were not older than the 2nd century B.C. and in no way comparable to the Mesolithic of Europe either culturally or in time.

Microliths have a very wide distribution in India. They have been found not only in the Mahadeo Hills, C.P., but, as Foote and subsequent investigators have shown, all along the southeast coast, in the Hyderabad and Mysore States, Central India, Gujarat, Kathiawar, Cutch, Sind and the Punjab. It would indeed be strange if in all these areas, some of which were the centres of highly advanced metal civilizations, at least from the 3rd century B.C. onwards, microliths were still used

as tools. The material culture—tools, weapons, etc.,—depicted in the sculptures at Amaravati, Nagarajunikonda, Bharhut, Sanchi and elsewhere as well as finds from the excavations at Kondapur, etc., indicate that much larger tools of metal were common. For a number of these areas, however, the question must remain open, until excavations reveal a stratigraphic sequence which will enable us to assign the microlithic industries to any definite period. Latterly such an evidence has been forthcoming from two areas for a prehistoric dating of the microlithic culture, and it is pointed out briefly in this note.

The evidence from Mahadeo Hill paintings discussed by Colonel Gordon[2] is not much helpful, for there is neither stratigraphic nor cultural relationship between the microliths and the rock-paintings. The former might be older, or contemporary with the paintings, which are themselves not of one period, but seem to extend over a thousand years. Very recently in the excavations at Brahmagiri in the Mysore State, Dr. M. H. Krishna[3] found microliths in association with neoliths in comparatively higher levels and *only* microliths in the lowest levels, the whole culture sequence including more than one stratum of iron age followed by the historic period attributed to the early centuries before Christ.

The Mahadeo Hill evidence may thus be regarded as exceptional and local and cannot constitute a rule for the dating of microlithic culture throughout India.

The latest evidence comes from the loess mounds at Langhnaj in Northern Gujarat, where digging has been in progress for the last three seasons. Here, as also in the small digging in the loess site at Hirpura, no metal objects have been found, as ordinarily they should have been, had the use of microliths survived as late as the 10th century A.D. Langhnaj along with many other localities in N. Gujarat was a flourishing village and has been in continuous occupation since then. These microlithic sites of N. Gujarat are not very far removed from the political and cultural centres throughout the historical period, while, as the Mahadeo Hill region is cut off from the main centres of civilization, we may assume there the survival of the Stone Age tradition to a later date. If the microliths at Langhnaj were so late as even the 2nd century B.C., some contemporary evidence in the shape of Indo-Greek or punch-marked coins, terrocottas, pottery, etc., should have been found along with the microliths.

So far we have discovered microliths and fossilized (calcified) skeletal remains after about 3 feet of digging in an unstratified loessic soil. These really constitute much more important evidence than the negative one. The juxtaposition and inter-relation in which these skeletons occur with animal remains, bone-and pebble-conglomerates, and microliths about the four-foot level, and the fact that human and animal remains are equally fossilized point to all of them being contemporaneous deposits. There is thus no ground to suppose that we have to deal with any but a prehistoric Stone Age culture.

The age of this microlithic culture in Gujarat rests largely on the degree of fossilization of our finds. Our studies on this point have so far been confined to ascertaining the exact nature of fossilization and its relative proportion to finds of old bones from preferably comparable deposits. On the latter point we find that bones discovered from historical sites, about 2,000 years old, are not at all fossilized; nor are the human and animal remains unearthed at Mohenjodaro and Harappa. Comparison with finds by Dr. De Terra[4] from an excavation in the upper loessic deposits at Uchali near Naushahra, in the Salt Range, Punjab is still more instructive. He found stray microliths and remains of *Homo sapiens* of dolicocephalic type and funerary pottery of handmade neolithic type. These remains were bleached and very brittle.[5] Such a poor state of preservation, as well as a general paucity of vertebrate fossil remains in the Potwar loess was attributed by De Terra to a high percentage of lime carbonate in the soil, which he considers really wind-borne silt, deposited in late Pleistocene to sub-recent times.

De Terra seems to be wrong in regarding the lime carbonate as destructive of bones. Usually it is believed to help compaction and mineralization. Many of the fossil remains in India and outside have been from limestone caves.

The mineral composition and chemical analysis of the Gujarat loess shows that it is almost of identical nature as the Potwar loess. It is in fact the alluvium of the Sabarmati and other rivers wafted back by wind and deposited all over the Gujarat plain as well as on high altitudes like the Taranga Hill. It contains a high percentage of lime, and a small proportion of the other constituents: magnesia, potash, phosphoric acid and nitrogen.

The present climatic conditions in N. Gujarat are not very much different from those in the N.W. Punjab. There are extremes of cold and heat, and periodic but not heavy rains. But unlike the Punjab, in the top soil of the loess we find human and animal remains which are not only highly calcified, but the proportion of fluorine to that of phosphoric acid is more than in the bones of the diluvian period in Europe. (Unfortunately, there is no data from India to compare with.) Like the Coldrum remains described by Sir Arthur Keith,[6] chalk has completely permeated the porous texture of the bones, there is a porcelain-like ring and the tongue adheres to the freshly fractured surface, showing that there is no organic animal matter left. And though, "there is no change of the nature of petrification or mineral replacement as in the true Siwalik mammalian fossils, still the change of the tissue" (says Mr. Wadia after kindly examining our specimens), "undergone by the bones, lying in a matrix of unconsolidated kaolin silt in the comparatively arid climate is sufficiently marked to give some index of their age".

We are, therefore, driven to the conclusion from

(1) the absence of metals,
(2) the paucity of pottery,

(3) the state of preservation of human and animal remains,

that the Gujarat microlithic culture is far older than that of Mohenjodaro. Of course, further evidence is necessary, and this may be had when detailed examination is made of animal remains, such as the exceptionally huge rib and shoulder blade, which appear to belong to certain animals, now extinct in Gujarat.

With regard to the comparison of the Gujarat microlithic culture with the European mesolithic or early neolithic there is no stratigraphic evidence yet available, except the meagre data from Mysore. However, attention may be drawn to certain features ... such as roundish pierced hammer-stone or mace-head with the hole splayed from above and below,, bone tools, absence of pottery, etc. ... of the Gujarat microlithic culture which can be compared to the European microlithic culture, without implying culture contact or even contemporary in time.

1. *Nature*, March 31, 1945, p. 386, *cf.* also *Nature* February 10 1945, p. 185. 2. *Indian Art and Letters*, 1936, pp. 35–41. 3. Presidential Address, Section of Anthropology 29th *Science Congress*, Baroda, 1942. 4. *Studies in the Ice Age in India and Associated Human Cultures*, pp. 275-78. 5. Even the remains of sub-recent fossil horse, dog, camel, and bovid discovered by Mr. D. N. Wadia, were, as he kindly informs me, very friable and difficult to extract from the ground, 6. Antiquity of Man, Vol. I, 9. 8.

THE OCCURRENCE OF *PARROTIA JACQUEMONTIANA* DCNE. IN THE PLEISTOCENE OF KASHMIR

By G. S. PURI, M.Sc., Ph.D.

Introduction

Among the photographs of the Karewa fossils sent by Dr. R. R. Stewart to Dr. H. de Terra in 1938 and later published by the latter in his memoir (see de Terra and Paterson, 1939, pls. 53, 54), one photograph (*loc. cit.*, pl. 53, fig. 3) illustrating two leaves of *Parrotia Jacquemontiana* Dcne., was reproduced under an incorrect name of *Quercus dilatata* Lindl. It may be recalled that Dr. Stewart under whom the author was working during 1937-1939 on de Terra's collections from the Karewa (Pleistone) deposits of Kashmir (Puri, 1939), sent to de Terra at his request twenty photographs and a preliminary list of the fossil species, so far identified by me, to show that the work on this material is in an advanced stage. But these photographs, together with the incomplete list of species, were pubished by de Terra in his above-quoted memoir (Puri, 1940), without any reference to me. The object of this note is to illustrate and briefly describe for the first time the fossils hitherto referred to *Quercus dilatata*, under the correct name of *Parrotia Jacquemontiana*, a large Himalayan shrub of the Celastraceæ.

Description

Parrotia Jacquemontiana Dcne.

The fossil leaves (attached to a twig) illustreated in Fig. 1 were collected by Dr. H. de Terra, the leader of the Karakoram Expedition to India in 1932, from the Karewa deposits, exposed in a stream-bed, near Liddarmarg (alt. 10,600 ft.; lat. 33° 48′; long. 74° 39′), a temporary encampment of Kashmiri shepherds, on the northern slopes of the Pir Panjal Range. The leaves, which were embedded in a blackish-grey clay, that splits fairly neatly along bedding planes, are rather poorly preserved and do not show finer details of venation. The leaf-lamina, which is somewhat obovate or nearly oblong in outline, is narrowed at the base and has an acute apex. The margins are irregularly and sharply toothed.

The venation is strict-pinnate and reticulate, it consists of a fairly broad midrib and 5-7 pairs of secondaries, which are about half as thick as the midrib, and diverge in an alternate manner at angles varying from acute to slightly abtuse. Some of the laterals bifurcate near the margins. The tertiary and finer reticulations are not well preserved but such

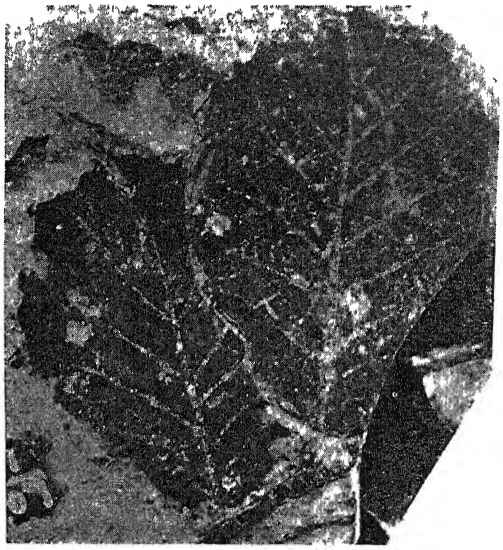

Fig. 1

as can be seen resemble closely those of living leaves of this species (Fig. 2). Organic matter of the leaf, too badly cracked to yield a good cuticular preparation, is present in both the leaves.

In shape, size, margins and details of venation our fossils are identical with *Parrotia Jaquemontiana* Dcne. (Fig. 2), a large shrub of the Western Himalayas. They are altogether different from *Quercus dialatata* (Fig. 3), under which they were placed by de Terra apparently by a mistake.

Number of specimens: Two only.
Occurrence: Liddarmarg, at 10,600 ft., Pir Panjal Range, Kashmir.
Collector: H. de Terra, 1932.
Reg. No. of figured specimen: Loc. 3L 36,

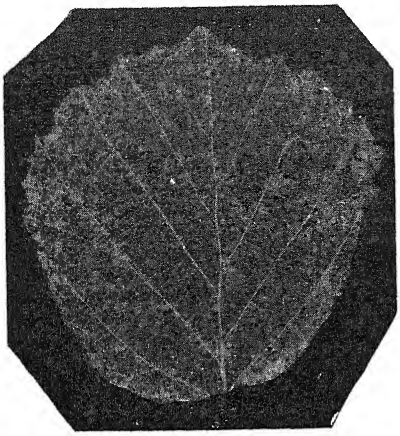

FIG. 2

FIG. 3

MODERN DISTRIBUTION OF THE SPECIES

Parrotia Jacquemontiana, popularly known as the "Himalayan witch-hazel", is a large deciduous shrub of the Western Himalayas, which grows in mountainous country, westwards from Jumna, at the altitudes of 3,000 to 8,500 ft. In the Kashmir Himalayas, especially towards the eastern end of the valley, it is gregarious in forests of *Cedrus deodara*.

In the moist deodar forests of the Kagan Valley in Hazara, *Parrotia Jacquemontiana*, which is very abundant, occurs in association with *Viburnum nervosum* under a canopy of *Cedrus Deodora*, *Pinus excelsa* and *Quercus dilatata*. Similar forests with *Parrotia* forming a thick undergrowth occur on drier aspects in the Chamba and Baspa Valleys, but in the Murree Hills, it prefers moist localities. According to Champion (1936, p. 240) the Kagan Valley forest "is typical of forests in which the tall shrub *Parrotia* forms a dense undergrowth unfavourable for deodar generation". On the northern slopes of the Pir Panjal Range, where *Cedrus* forests are already so poorly represented Sher Singh (1929) considers *Parrotia* "a dangerous competitor of deodar in wet places". The same author while explaining the absence of deodar forests from the northern slopes of the Pir Panjal remarks that a high humidity resulting from a greater snow-fall in these regions creates unfavourable conditions for the growth of deodar. This contention of Sher Singh finds support from the fossil evidence, which I propose to discus elsewhere.

In the dry temperate mixed evergreen forests of Kilba, Upper Bashahr Division, *Parrotia Jacquemontiana* occurs in association with *Rhus succedanea, Olea cuspidata, Zanthoxylum alatum, Artemisia maritima, A. vulgaris, Daphne oleoides, Rosa Webbiana, Berberis* spp., *Lonicera angustifolia, Abelia triflora, Sophora mollis, Celtis australis, Acer pentapomicum, Quercus, Ilex, Cedrus Deodara* and *Pinus gerardiana* (Champion, *loc. cit.*, p. 254).

The Kashmir distribution of the species with which we are specially concerned is chiefly restricted to the valley proper where shrubby plants of *Parrotia* ascend to an altitude of about 6,500 ft. on the Pir Panjal.

The wood of this shrub in Kashmir is said to possess certain miraculous properties; sticks of *Parrotia* are often found in the hands of Kashmiri hill-tribes men to guard them against snakes, which are believed to be repelled by an aroma coming out of its wood.

CONCLUSIONS

A comparison of the past and present distribution of the species provides further evidence in favour of the theory that the Kashmir Himalayas have been uplifted by at least 5,000 to 6,000 feet after the deposition of the Karewa lake beds (see Puri, 1943, 1945, 1945*a*, 1946) at the level of the valley (about 5,200 ft.). These youngest deposits of the valley were bodily dragged by the Pleistone orogeniec on the neighbouring mountains where they lie tilted, sloping towards the valley, being unconformably overlain on the solid bed-rock.

The testimony of other fossil species, which have been discovered from this locality also points in the same direction (Puri, 1943, 1945, 1945*a*).

In the end, I wish to record my indebtedness to Prof. B. Sahni, F.R.S., for helpful criticism.

1. Champion, H. G., "A preliminary survey of the forest types of India and Burma," *Ind. For. Rec.*, 1936, New Series, No. 1. *Silviculture*. 2. de Terra, H., and Paterson T. T., "Studies on the Ice Age in India and associated human cultures," *Carnegie Institution, Washington*, 1939. 4. Puri G. S., "The Pleistocene flora of Kashmir, Part I," *Proc. Ind. Sci. Congress* 1939, Lahore. 5. —, "Palæobotany in India, II," *Journ. Ind Bot. Soc.*, 1940, 19. 6. — "The occurrence of *Woodfordia fruticosa* (Linn.) S. Kurz., in the Karewa deposits of Kashmir, with remarks on changes of altitude and climate during the Pleistocene," *Ibid.*, 1943, 22. 7. —, "Some fossil leaves of *Litsæa lanuginosa* Nees. from the Karewa beds at Liddarmarg, Pir Panjal, Kashmir," *Ibid.*, 1945, 24, No. 3. 8. —. "The genus *Quercus* in the Karewa deposits of Kashmir, with remarks on the oak forests of the valley during the Pleistocene, *Proc. Ind. Acad. Sci.*, 1945 *a*," 22 No. 4. 9. —, "Fossil plants and the Himalayan uplift," Accepted for inclusion in the *Iyengar Commemoration Volume*, 1946. 10. Sher Singh, "The effect of climate on the conifers of Kashmir," *Ind. For.*, 1929, pp. 189–203.

TECHNIQUES IN THE STUDY OF NUCLEAR FISSION*

BY

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(Department of Physics, Central College, Bangalore)

THIS note gives an account of the different experimental techniques that have been employed so far in the study of the phenomenon of the fission of the atomic nucleus.

Soon after Hahn and Strassmann[1] announced in the columns of *Naturwissenschaften* of January 1939, their discovery of the possible splitting of the uranium atomic nucleus by the entry of a neutron, studies of the phenomenon were taken up at Copenhagen, Paris, Washington, Princeton, Baltimore and San Francisco. Measurements of the energy release with an ionisation chamber coupled to a linear pulse amplifier and an electro-mechanical oscillograph[2] gave a value of about 100 Mev. for the lighter fragment and about 75 Mev. for the heavier one. Wilson expansion chamber studies gave a value of about 22 mm. for the range of fragments in ordinary air. Expansion chamber studies[4] in Bohr's laboratory at Copenhagen show that the tracks have features characteristic of the big charge and heavy mass of the fragments. Chemical analysis of the fission products, notably in the hands of Lise Meitner, has led to the identification of about 100 different radioactive isotopes belonging to 25 different elements. Since chemical methods of separation are unable to identify short-lived products and since the splitting of the nucleus takes place in different ways—a feature well brought out in the comprehensive theory of nuclear fission developed by Bohr and Wheeler,[6] chemical investigations do not directly reveal the formation of two complementary primary fission fragments.

Frisch was the first to point out that the big mass and charge of the fragments will give rise to an intense ionisation along their paths. About 3 million ion pairs are formed along the track of each fragment and the charge delivered to the collecting electrode in the ionisation chamber is about 5×10^{-13} coulomb. Frisch[7] used 300 mg. of radium bromide mixed with beryllium powder, for the source of neutrons. When the ionisation chamber was lined with uranium oxide on its inner surface, only about 30 fission counts per minute were observed, while one millicurie of a Rn-Be source is estimated to emit 15,000 neutrons per second. Experiments similar to that of Frisch have been carried out[8] in U.S.A. using the Van de Graaf generator or the cyclotron and the Be-D, Li-D or the D-D nuclear reaction for the generation of neutrons. Although the electrostatic generator does not give an accelerated ion current comparable with that of the cyclotron, it gives a steadier voltage.[9] The beryllium deuteron nuclear reaction gives the richest yield of neutrons. The Li-D reaction gives neutrons of 13·5 Mev. maximum kinetic energy and the D-D reaction using a heavy ice target 2·5 Mev. mono-kinetic neutrons. The neutron intensity with 1,000 KV. one micro-ampere deuteron current bombarding beryllium is estimated to correspond to that from 10,000 millicuries of radon-beryllium. To measure the efficiency of slow neutrons as compared with that of fast ones, in brining about fission, the ionisation or the expansion chamber, enclosing the irradiated uranium layer, and in some cases the neutron source as well, and surrounded by a block of paraffin. It is found that neutrons of energy between 0·5 and 2·5 Mev. are most effective in producing fission and the cross-section is estimated to be about 2×10^{-24} cms.[2]

Zinn and Szilard[10] studied the emission of *fast* neutrons from uranium when irradiated by *slow* neutrons, the source being a radium-beryllium photo-neutron source embedded in a paraffin block. The fast neutrons were detected by an ionisation chamber filled with helium and the interspace between the neutron source and the chamber contained thick layers of lead and uranium. Fermi and his co-workers at the Columbia University[11] used a different experimental arrangement. A Rn-Be source of neutrons was placed at the centre of a 13 cm. diameter spherical bulb, immersed in a tank of water to slow down the neutrons. The induced beta-activity on a rhodium metal foil placed at different distances from the source of neutrons was measured with and without uranium oxide inside the bulb. From the measured variation in the induced activity of the foil and the geometry of the experimental arrangement, the average number of secondary neutrons was estimated to be nearly two. Joliot and his co-workers[12] find a value of $3 \cdot 5 \pm 0 \cdot 7$ neutrons per fission, from their experiments.

Lise Meitner was the first to point out that the recoil phenomenon may be used for the separation of the fission products. This method has been used by a number of investigators to isolate and study the radioactivity of the products.[13] If a stalk of cellophane foils of suitable thickness is placed close to the fissuring layer at different distances from it, the different groups of fission products can be collected and their beta-activity studied by wrapping the foils around thin-walled Geiger-Muller counters. If the neutron irradiation is carried out for a considerable time,—30 to 60 minutes when the cyclotron is used,—the collected products on the foils can be analysed for their chemical identification. In her latest experiment, in Siegbahn's laboratory, Lise Meitner[14] places the foils and the uranium-coated plate inside the dee-chamber of the cyclotron. To study the H-distribution by deflecting the fission fragments in the magnetic field of the cyclotron itself, Lassen,[15] working in Bohr's laboratory at Copenhagen, places the ionisation

* Based on a talk given by one of the authors (C. K. S.) at the Discussion on "Nuclear Fission" in the Physics Section of the Indian Science Congress Session (2nd to 8th Jan. 1946), at Bangalore.

chamber also inside the dees of the cyclotron. tron.

1. Hahn and Strassmann, *Naturwiss*, 1939, **27**, 16. 2. Roberts, *et. al. Phy. Rev.*, 1939, **55**, 416; Anderson, *et. al. Ibid* 797. 3. Joliot, *C. R.*, 1939, **203**, 647. 4. Bogild, *et. al.*, *Phy. Rev.*, 1941. **59**. 275. 5. Thibaud and Mousa, *C. R.*, 1939, **208**, 642 6 Bohr and Wheeler. *Phy. Rev.*, 1939, **56**, 426; 1065. 7. Frisch, *Nature.*, 1939, **143**, 8?2. 8. Kanner and Barschall, *Phy. Rev.*, 1940 **57**, 372. 9. Sundaracbar, Streib, and Raghavendra Rao., *Curr. Sci.*, 1941, **10**. 124. 10. Zinn and Szilard, *Phy. Rev.* 1939, **55**, 619 11 Anderson, H.L., Fermi and Hanstein., *Phy. Rev.*, 1939, **55**, 797. 12. H. von Halban, Joliot and Kowarski, *Nature*, 1939, **143**, 680. 13. Joliot, *C. R.*, 1939, **203**, 341; Segre. *Phy. Rev.*, 1939 **55**, 1104. 14. Lise Meitner, *Rev. Mod. Phy*, (Bohr Number) April–July 1945, p 287s 15. Lassen, E. O., *Phy Rev.*, 1945, **68**, 142.

STATISTICS AND NATIONAL PLANNING*

STATISTICAL SCIENCE, after passing through several stages of neglect and pseudo-scientific activity, has now well established itself into the very fabric of our thought. In a diversity of scientific fields the foundations are those laid on observations and statistics, and the technique is the logic which enables the measurement of essential factors to be made simultaneously from a number of different angles and assumes the probability basis. In business and industry, statistical research has now gone beyond market problems to the determination of consumption patterns and the setting up of standards and of quality control in production. Governments, however, are the largest creators, preservers and sometimes destroyers of statistical information. National disasters, wars, famines, pestilences and now, reconstruction planning have forced Governments to adopt new and quick methods for obtaining facts and to adopt policies suggested by them. In these essential requirements Statisticians have, in spite of many handicaps, played an important role in recent years.

The most remarkable development from the point of view of administrations is the confidence now being placed in the suitability of the method of investigation by sample. A large number of schemes for ascertaining the several facets of economic life of the country, such as cost of living, variations in employment, vilume of postal transactions, traffic density, etc., are now operated on the sample method. The failure to proceed with full tabulation at the census of 1941 had left this country without the basic information of age, sex and civic condition of the people which are essential for scientifically estimating the growth of population. Prof. Madhava, who worked on a Committee of Government which investigated the characteristics of sample slips that had been preserved under orders of the Census Commissioner, reported that satisfactory age tables, life tables and projections can be obtained on the basis of the sample slips. Such a means of repairing the lacuna that had been created was of obvious significance when it is realised that in the final analysis planning has to be based for people in relation to their numbers, their distribution, their ages and their means of livelihood. In food planning too, the weightage to be given to persons according to their ages in the consumption of different articles of food was a basic requirement. Traffic density and the capacity of several economic factors to contribute to traffic were foundations on which plans for the development of communications and transport had to be based. Professor Madhava gave an account of his recent work in these directions and observed that no planning was possible or sensible, without first planning for facts.

Recent opportunities for the extension of statistcial work had brought to light the acute shortage of suitably trained persons and the paucity of college teachers who had sufficient profundity and versatility to cover every conceivable application of such a method. The most rapid way of remedying these defects was through the development of independent statistical schools in Indian universities, and through industrial laboratories and non-official institutes which would give, through their project work, training not only in technical work but in field work and computation also. Statistical work was rapidly developing as a professional service, and in due course questions concerning recruitment, classification and the placing of statisticians in Government, industry and the professions would become live issues. Professor Madhava pleaded for frequent contacts and interchange of views amongst statisticians and others in this country and outside.

* Abstract of Prof. K. B. Madhava's Presidential Address to the Section of Statistics, Indian Science Congress Bangalore, 1946.

ELASTIC CONSTANTS OF CRYSTALS*

PROF. BHAGAVANTAM has described a new method for measuring the elastic constants of materials available in the shape of small plates. Wedge-shaped sections cut from piezo-electric crystals, such as quartz or tourmaline, are used for generating ultrasonic waves by employing them in high frequency oscillatory circuits of the standard type. As the exciting frequency of the electrical circuit is varied, an appropriate portion of the wedge responds to the electrical frequency and thus it becomes possible to obtain a continuous band of ultrasonic frequencies, the width of the band depending upon the dimensions of the wedge. By using two or three such wedges, an appreciable range, say one to fifteen megacycles per second, may be covered. When one of the oscillating wedges is laid on a crystal plate or a plate or a plate cut out of an isotropic material, sound waves of certain chosen frequencies are transmitted with maximum intensities. This fact of favoured transmission is detected by allowing the transmitted wave to get into a liquid and form a grating which is used in the usual type of optical arrangement for producing the Debye-Sears diffraction patterns. The frequencies corresponding to such trans-

* Summary of the Presidential Address delivered by Prof. S. Bhagavantam, before the Section of Physics Indian Science Congress, Bangalore, 1946.

mission maxima are measured with an accurate wave meter and the corresponding sound velocities in the material calculated from its known thickness. In general, there are three sound velocities associated with any thickness direction for a material and they are related to the elastic constants or linear combinations of them in a manner that may be determined in each case by taking into consideration the symmetry of the crystal and the orientation of the plate chosen for investigation. In the simplest case, namely, that of an isotropic substance, two of the velocities coincide and lead to the rigidity modulus and the third one which is distinct leads to the Young's modulus. Relationships in crystals are more complicated.

This method has been developed in detail and the individual elastic constants of diamond measured for the first time. The merit of the newly developed method lies in its wide scope as may be seen from the fact that a substance like diamond, small sections of which only can be made available for experimental purposes, has lent itself for study. Zinc-blende, galena, iron pyrites, rock-salt, apatite, quartz, calcite and sodium nitrate are amongst the other substances studied. The theoretical significance of the results in general and their relationship to the spectroscopic data in particular have been discussed. Such studies may be extended to solving other problems of fundamental interest and as an example is mentioned the case of mixed crystals. Results obtained with seven different specimens of garnets collected from different parts of India are given and some of their features noted.

The method is also capable of being extended for the purpose of studying certain problems which were not within the reach of the older and already familiar technique of measuring elastic constants. A suggested line of investigation relates to the effect of temperature and of electric and magnetic fields on the elastic constants of different materials.

BOTANY AND HUMAN WELFARE*

PLANT introduction on a systematic and extensive scale followed by subsequent breeding plays a very important role in the improvement of the desired strain. Wild or semi-wild varieties could be incorporated in the commercially cultivated varieties of crop plants by hybridisation in order to overcome many of the most pressing problems of crop production. Improvement of potato by a recombination of the genes of the wild and cultivated species and varieties through hybridisation has been a bright programme in America. Introduction followed by subsequent breeding has been responsible for the varieties on which the American-Egyptian extra-long staple cotton industry is based. Similar methods preserved the Java sugarcane which would otherwise have become extinct. The establishment of a Bureau of Plant Introduction in India on the lines of those in America and Russia is long overdue.

Breeding has been the widest application in India. After selecting the high-yielding plants and discarding the others, further progress is possible by the method of hybridisation. Extensive work along these lines conducted by the Agricultural Research Institute have resulted in the famous Pusa 4 and Pusa 12 wheats and have demonstrated that there exist Indian wheats which are equal in quality to good Manitoba wheat. Existing improved wheats are good yielders, give grain of excellent quality and have good standing power. The importance of evolving a variety which possesses all these qualities together with a resistance to the attack of rusts cannot be denied. When once such a variety is grown in the hills, the chances of infection in the plains would be reduced, apart from the value of such wheats to the hill farmers themselves. A programme to reach the target has been initiated in two stages: (1) breeding of varieties resistant to the black, brown and yellow rusts respectively and (2) synthesis of further varieties embracing resistance to all the three rusts simultaneously. As none of the indigenous varieties tested possessed much resistance (excepting Pusa 120), hybridisation with exotic varieties which were virtually immune to the rusts was adopted. Now varieties respectively resistant to all the races of yellow and brown rusts have been built up and varieties resistant to all the Indian races of black rust too are expected to be obtained shortly.

Unlike the position with regard to rusts, fortunately India possesses several good wheats which have a high resistance to smut and further breeding work is necessary to evolve a smut-resistant wheat. There is also a need for varieties which can give good crop of ripe grain with a minimum quantity of water, a programme towards which has been started recently.

In out-pollinating crops like maize, *bajra*, *Brassicæ*, cabbage, etc., single plant selection is impossible. Heterosis, which usually results on crossing two inbreds, and the standardisation of breeding technique has revolutionised maize production in America. About the year 1920 double crosses were obtained which were more adaptable and less susceptible to adverse conditions of growth. Such commercial hybrids yielded 40 per cent. more over the standard varieties. In addition they were uniform and more able to withstand draught, wind, disease, etc., than the best open pollinated varieties. In India no serious attempts have so far been made to exploit hybrid vigour.

Vegetatively-propagated plants, grasses and forage crops, vegetables, fruits and forest trees have not received any methods of improvement in India. The importance of evolving disease-resistant varieties, in spite of the several precautionary or remedying measures under practice, becomes exemplified in a country like India where the average farmer is too poor to be able to afford the cost of spraying and dusting.

In India vernalisation would be of value only in regions where special conditions prevail which render the growing of crops a precarious operation. The direct application of vernalisation to agriculture does not appear to hold much promise; it is, however, of great value in the speeding up of plant breeding. Introduction of and research on growth-hormones is full of possibilities for the future. Hydroponics does not give promise of immediate application to agriculture.

B. G. L. S.

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* Abstract of Dr. B. P. Paul's Presidential Address to the Section of Botany, Indian Science Congress, Bangalore, 1946.

LETTERS TO THE EDITOR

A PECULIAR GAP-FILLING PROCESS FOR POWERS OF $(9)_n$

IN the *B.U.J.*,* Mr. Kaprekar has considered a few examples in the gap-filling process for powers of $(9)_n$. In that note, he has taken powers only upto 5. In this note, I establish a method for the gap-filling process whatever be the power. Moreover in this method, we need not calculate the value of the different powers of 9, which are necessary in Mr. Kaprekar's method.

Notations.—(1) $(9)_n$ stands for the digit 9 repeated n times and $(9)^k{}_n$ stands for the k^{th} power of $(9)_n$.

(2) p is defined by the relation,

$$10^{p-1} < {}^kC_r \leqslant 10^p, \text{ where } r = \frac{k}{2} \text{ if } k \text{ is even,}$$

$$\text{and } = \frac{k-1}{2} \text{ if } k \text{ is odd.}$$

(3) k and n are positive integers and $n \geqslant p$.

(4) When we call (x) a p digit number; if x does not contain p digits we mean that the necessary number of zeros are prefixed to x so as to make it a p digit number. *e.g.*, if $p = 3$ and $x = 35$, we take $(x) = (035)$.

With these notations we will show that $(9)_n{}^k = \ldots\ldots (10^p - {}^kC_1) \ldots\ldots ({}^kC_2 - 1) \ldots\ldots (10^p - {}^kC_3) \ldots\ldots ({}^kC_4 - 1) \ldots$ where $(10^p - {}^kC_1)$, $({}^kC_2 - 1)$ etc, are all p digit numbers and the gaps from left to right are filled in by $(9)_{n-p}$ and $(0)_{n-p}$ alternately, thus making it

$$= (9)_{n-p}(10^p - {}^kC_1)(0)_{n-p}({}^kC_2 - 1)(9)_{n-p}(10^p - {}^kC_3)(0)_{n-p}({}^kC_4 - 1)$$

The last p digits being by ${}^kC_k$ or $(10^p - {}^kC_k)$ according as k is even or odd.

Proof.—$(9)_n{}^k = (10^n - 1)^k$

$$= 10^{nk} - {}^kC_1 \cdot 10^{n(k-1)} + {}^kC_2 \cdot 10^{n(k-2)} - {}^kC_3 \cdot 10^{n(k-3)} + \ldots$$

$$= [10^n - {}^kC_1] \cdot 10^{n(k-1)} + [{}^kC_2\, 10^n - {}^kC_3] \cdot 10^{n(k-3)} + \ldots$$

$$= [(9)_{n-p}\, 10^p + (10^p - {}^kC_1)]\, 10^{n(k-1)} + [({}^kC_2 - 1) \cdot 10^n + (9)_{n-p}\, 10^p + (10^p - {}^kC_3)] \cdot 10^{n(k-3)} \ldots$$

$$\text{since } 10^n - 10^p = (9)_{n-p} \cdot 10^p$$

$$= [(9)_{n-p} \cdot (10^p - {}^kC_1)]\, 10^{n(k-1)} + [({}^kC_{2-1})\,(9)_{n-p}\,(10^p - {}^kC_3)]\, 10^{n(k-3)} + \ldots$$

since $(10^p - {}^kC_1)$ etc are p digit numbers.

$$= (9)_{n-p}\,(10^p - {}^kC_1) \cdot (0)_{n-p}\,({}^kC_2 - 1)\,(9)_{n-p}\,(10^p - {}^kC_3) \ldots$$

$$= \ldots (10^p - {}^kC_1) \ldots ({}^kC_2 - 1) \ldots (10^p - {}^kC_3) \ldots ({}^kC_4 - 1) \ldots,$$

where $(10^p - {}^kC_1)$, $({}^kC_2 - 1)$, etc., are p digit numbers; and the gaps are filled in with $(9)_{n-p}$ and $(0)_{n-p}$ alternately.

When $k \leqslant 5$. $p = 1$ and so the problem is simple.

Ex.—$(9)_4{}^5 = -5-9-0-4-9$ to be filled in by $(9)_3$ and $(0)_3$ alternately $= 999\ 5\ 000\ 9\ 999\ 0\ 000\ 4\ 9999$.

We find that

$p=1$ if $k \leqslant 5$ $\quad$ $p=2$ if $6 \leqslant k \leqslant 8$
$p=3$ if $9 \leqslant k \leqslant 12$ $\quad$ $p=4$ if $13 \leqslant k \leqslant 15$
$p=5$ if $16 \leqslant k \leqslant 19$ $\quad$ $p=6$ if $20 \leqslant k \leqslant 22$.

Note—Whatever be the value of $n\ (> p)$ to write down $(9)_n{}^k$, we have to calculate ${}^kC_1$, ${}^kC_2 \ldots {}^kC_k$ only.

Trivandrum, S. PARAMESWARAN.
August 29, 1945.

* *Bombay University Journal*, March 1945.

THE EFFECT OF COLOUR ON THE VISUAL OBSERVATION OF LONG-PERIOD VARIABLE STARS

THE part played by colour in the errors involved in the visual observation of long-period variables was pointed out by Ford.[1] In order to verify the linear relationship between colour and mean deviation as derived by him, a study of twenty stars of varying colour was made utilising the same methods of analysis. The observational data were taken from the A.A.V.S.O. Reports in *Harvard Annals*, Vol. 107, Nos. 7 and 8, and Vol. 110, Nos. 1, 5, 6, 7 and 8. The deviations for each individual

observer were calculated for each night and a standard deviation σ_m for each star was computed by adopting the formula

$$\sigma_m = \sqrt{\frac{\Sigma \delta^2}{N}}, \tag{1}$$

where $\Sigma \delta^2$ is the sum of the squares of the deviations, and N the total number of observations made. Due to the uncertainty of the colour indices of long-period variables the Orthoff colour scale[2] used on A.A.V.S.O. charts was employed.

In Table I, the results are given.

TABLE I

No.	Design	Name of Star	Colour	σ_m
1	*053005a*	T. Orj.	0·0	0·36
2	123307	R. Vir	1·3	0·18
3	103769	R. Uma	1·6	0·27
4	115158	Z. Uma	2·0	0·24
5	123160	T. Uma	2·0	0·23
6	181136	W. Lyr	3·0	0·32
7	123961	S. Uma	3·2	0·30
8	142539a	V. Boo	3·6	0·32
9	*233815*	R. Aqr	4·3	0·27
10	024356	W. Per	4·9	0·30
11	*021403*	O Cet	5·0	0·27
12	021558	S. Per	5·0	0·22
13	193449	R Cyg	6·0	0·29
14	162119	U. Her	6·5	0·29
15	*162112*	V. Oph	6·6	0·24
16	094211	R. Leo	6·9	0·28
17	054920a	U. Ori	7·0	0·32
18	001755	T. Cas	7·3	0·32
19	201647	U. Cyg	8·4	0·32
20	200938	RS. Cyg	10·0	0·31

Fig. 1 shows the correlation between colour and σ_m for which a relation

$$\sigma_m = 0{\cdot}0124\,C + 0{\cdot}2157 \tag{2}$$

was derived.

Ford's relation

$$\sigma_m = 0{\cdot}0205\,C + 0{\cdot}176 \tag{3}$$

can be seen to differ considerably from the new relations derived. The notation σ_m in equation (2) indicates a standard deviation in magnitudes, and C is the colour on the Orthoff scale.

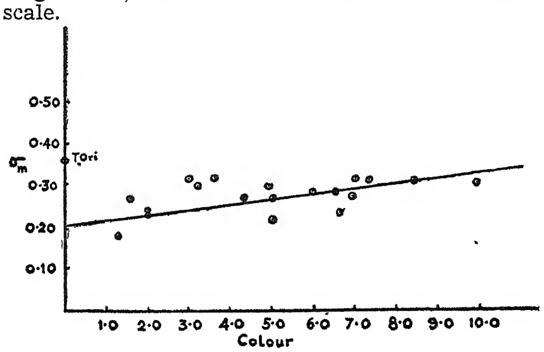

FIG. 1

It can be seen from Fig. 1, that T. Orionis 053005 a has an unusually high error which can be explained as due to the Dove effect.[3]

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1. *Pop. Astr.*, **48**, 9. 2. *A. N.*, 1900, **153**, 141 1912, **192**, p. 85. 3. Furness, *Introduction to the study of Variable Stars.*

LIGHT-SCATTERING IN AQUEOUS TIMBER WOOD EXTRACTS

THERE are immense possibilities, as one of the authors has pointed out some time ago,[1] for the application of the method of light-scattering to the solution of problems in several fields of scientific investigation. One such problem is that of Identification of Timber Woods. The only optical work so far carried out in this connection is by Shah and Singh,[2] who have recently studied the absorption spectra of some aqueous timber wood extracts. They arrive at the qualitative result that the spectra for the different extracts they investigated are very dissimilar. A study of the factors of depolarisation of the light transversely scattered in aqueous timber wood extracts is capable of yielding reproducible and characteristic values for each specimen and would also throw valuable light on the state of dispersion in the medium of the scattering elements.

Five important timber woods from amongst those commonly used to make furniture were chosen for the present work. They are: (1) Teak wood (*Tectona grandis*), (2) Red cedar (*Eugenia manogynum*), (3) Chittagong wood (*Chikrassia tabularis*), (4) Moulmein cedar (*Cedrella toona*) and (5) Rose wood (*Dalbergia latifolia*). Fine shavings of these specimens were obtained by planing and kept inside a desiccator for three days. The extracts were prepared by boiling 2 gms. of the dried shavings with 150 c.c. of pure distilled water for ten minutes. They were then rendered mote-free by filtration through a few layers ash-free filter-paper and transferred into spherical resistance glass flasks. The depolarisation factors ρ_u, ρ_v and ρ_h, with the incident light respectvely unpolarised and vertically and horizontally polarised,[3] were determined by the usual Cornu method. Suitable precautions were taken to eliminate or minimise all the incidental sources of error.

The results of the investigation are given in Table I. $\Delta\rho_u$ in the last column of this table

TABLE I

Extract	ρ_h %		ρ_u %	ρ_v %	$\Delta\rho_u$ %
	Observed	Calculated			
Rose wood	11	15	7·1	0·95	5·2
Red ceder	36	33	8·6	2·2	5·2
Teak wood	32	37	6·2	1·7	2·8
Moulmein cedar	39	41	5·1	1·5	2·2
Chittagong wood	59	63	8·2	3·3	1·8

is the difference between the observed value of ρ_u and the anisotropic part of pu, which may, to a first approximation, be considered as equal to $2\rho_v/1 + \rho_v$). This is a function of the size of the scattering centre.[4]

From an analysis of these results, the following significant conclusions can be drawn :—

(1) The appreciable departure of ρ_h from the normal value of unity[5] shows that all these extracts are colloids. This was verified by the fact that coagulation could be brought about in all these extracts by the introduction of a few drops of a suitable electrolyte.

(2) The values of ρ_u and ρ_v are unique in each case and can be relied upon for the identification of the respective timber woods. The experiments were repeated three times under similar conditions with different specimens of the same species of timber wood and the results were found to be substantially the same as above.

(3) $\Delta\rho_u$ and ρ_v, which may respectively be taken as indicative of the size and anisotropy of the elements of optical inhomogeneity, are different for the different extracts.

It is interesting to note from Table I that the scattering elements in rose wood sol, which have the largest relative size, seem to have the least relative anisotropy; while those in the Chittagong wood sol, which have the least relative size, show the maximum relative anisotropy.

Further investigations with non-aqueous and saturated extracts of different timber woods are in progress.

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1. Venkateswara Rao, D., *The Ceded Districts College Magazine*, 1942, **15**, 1–7. 2. (Miss) Shah, R., and Singh, T. C. N., *Curr. Sci.*, 1944, **13**, 178–79. 3 Krishnan, R. S., *Proc. Ind. Acad. Sci.*, (A), 1935, **1** 915–27. 4 Krishnan, R. S., and Venkata Rao, P. *Ibid.*, 1944, **20**, 109–16. 5. Venkateswara Rao, D. *Ibid.*, 1942, **15**, 24-34.

SELECTIVE EXCITATION OF SPECTRA BY HIGH-FREQUENCY DISCHARGE

A SERIES of interesting observations about the selective excitation of spectra in discharge tubes by the high frequency oscillations have already been reported[1,2,3] and some of them also explained in terms of the excitation function[4,5] of the initial levels involved. From a H-type of discharge tube containing helium and mercury it is found that by varying the frequency of oscillations and using internal or external electrodes we may excite either mostly helium or mostly mercury. For certain frequencies of oscillations the glow remains in the broader portion of the tube and is greenish in colour containing mostly mercury and for other frequencies of oscillations the glow passes through the capillary, connecting the two broader portions and is greyish red containing mostly helium. The high frequency circuit used is of the Hartley type of the range from 200 metres to 500 metres of wavelength of oscillation. The coupling used in this case seems to be of the loose type, so that the maximum glow is obtained for two positions of the variable condenser.

Some other discharge tubes of the straight type, one containing hydrogen, the other helium with a trace of neon and a third containing neon only have been excited by the same circuit and a detailed investigation made within this range in the visible region by the constant deviation spectroscope. In all these cases separately taken there does not seem to be any relative change of intensity in the lines and the bands of the same spectrum, though there is a general change in the intensity of the spectrum as a whole. In the case of hydrogen the triplet bands seem to be more prominent in intensity at all the frequencies as compared to the singlet system. The energy available in the circuit seems to be of the order of 10 e.v. to 18 e.v.

These phenomena seem to be understandable in terms of the excitation functions of the initial levels and the mechanism of the wireless circuit used. The details will be published elsewhere.

My thanks are due to Dr. R. K. Asundi, Benares Hindu University, for guidance in the work.

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December 3, 1945.

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TAMARIND SEED "PECTIN"

WE read with interest the note on the above subject by Ghose and Krishna (1945);[1] we were particularly interested in the statement that they "have not been able to get *l. arabinose* amongst the products of hydrolysis or repeat the other data reported by Damodaran and Rangachari (1945).[2]" The "other data" referred to were: (*i*) tamarind seed when analysed for pectin according to Carré and Haynes (1922)[3] gave no calcium pectate; (*ii*) analysis for methoxyl and uronic acid gave extremely low values compared to genuine pectin; (*iii*) no galacturonic acid could be isolated from the product after acid hydrolysis; (*iv*) on the contrary, the hydrolysate consisted of a mixture of pentose and hexose sugars which were quantitatively estimated and in which *glucose* and *arabinose* were identified.

To compare these data with those obtained by Ghose and Krishna (1945)[1]: (*i*) no estimation of pectin by the standard method appears to have been made by them although this would have been the simplest method of

ascertaining if the substance they were dealing with was pectin; (*ii*) while we obtained values for methoxyl and uronic acid that were *too low* for pectin, Ghose and Krishna found *no* methoxyl or uronic acid (although some unknown acid grouping must be present in their preparation as they speak of a "very low acid number"); (*iii*) like us they failed to obtain any galacturonic acid on hydrolysis; (*iv*) as in our experiments their acid hydrolysate contained a mixture of hexose and pentose in which they identified *glucose* and *xylose*.

The discrepancy in the findings regarding the identity of the sugars is not surprising in view of the fact that we are dealing not with a homogeneous product but with a mixture such as is bound to result from a natural product by simple extraction with water and precipitation with alcohol. The components of such a mixture can be expected to vary according to the conditions of preparation. Our product was obtained by the method as originally described by Ghose and Krishna (1942),[4] namely, extraction of the *ground* seed kernel with water and precipitation by alcohol. Ghose and Krishna have used for analysis a preparation obtained by extraction of pea-size fragments. This slight modification was sufficient, on their own showing, to cause a fall in the protein content of the preparation of about 12 per cent. Corresponding differences in the carbohydrate components are equally to be expected. Obviously there can be no question of studying the chemical constitution of such a heterogeneous mixture until a fraction of constant composition has been isolated from it by preparative methods which would have to be much more specific than mere extraction with water and precipitation with alcohol. Nor was it our object to make such a study in chemical structure. Our data were presented to show that the preparation from tamarind seed, whatever its chemistry may turn out to be, was not a pectin. Pectin as a subgroup of the vegetable mucilages is characterised by being built up mostly or entirely of partially methoxylated galacturonic acid units. The results obtained by us as well as by Ghose and Krishna are in agreement in showing that the substance under consideration does not conform to this composition.

It is necessary not to confuse the issue by emphasising unimportant differences in the analytical results, which, as has been already pointed out were inevitable with the kind of inhomogeneous preparation that was being dealt with, or by references to preparations wrongly called pectin before the chemical nature of pectin was understood. The reference made to Gorter's[5] paper in 1908 in which a substance containing only hexoses and pentoses was called a pectin is as relevant to the present definition of pectin as the original misconception that vitamins are amines is to modern vitamin chemistry. It is true that tamarind seed mucilage has one of the physical characteristics of genuine pectin, that of forming a jelly in the presence of sugar and acid. But on the other hand in another physical property it differs from genuine pectin and resembles starch, *viz.*, in yielding a gummy substance on treatment with borax, a property of starch which is made use of in the manufacture of adhesives. Even in regard to jelly-forming ability the analogy between the product from tamarind seed and pectin is incomplete, as pectin is demethoxylated by treatment with alkali and then loses its jelly-forming ability which is dependent on the presence of methoxyl groups, while the material from tamarind seed appears to be unaffected by such treatment. In any case a chemical classification based upon physical properties would place agar-agar and gelatin in the same chemical group.

Apart from questions of definition and classification, correct characterisation of pectin on chemical grounds is important from the point of view of industrial applications also. The chief commercial uses of pectin are (*i*) for the fortification of jams and preserves from fruits whose natural pectin content is not sufficient to give the desired consistency and (*ii*) for the manufacture of galacturonic acid for vitamin C synthesis. The justification for the use of pectin for the former purpose rests, in the first place, on its being a natural constituent of edible fruits and secondly on what we know of the biochemistry of uronic acids. It is well known that uronic acids are utilised in the human body for detoxication purposes and there is some evidence that the galacturonic acid formed by the hydrolysis of pectin by bacterial enzymes in the large intestines (Kertesz, 1940)[6] may be absorbed and similarly utilised (Manville, Bradway and McMinis, 1936).[7] It is, however, quite a different matter to introduce into food products hexosans or pentosans from non-edible seeds whose behaviour in the alimentary tract is not known—and whose most probable fate would be to undergo fermentation in the colon and produce gas. As to the second application it is obvious that tamarind seed mucilage containing little or no galacturnic acid cannot be used as a source of this substance. The object of our investigation, as has been previously stated,[2] was in fact, to discover suitable sources of pectin for the preparation of galacturonic acid and as our results published elsewhere show (Damodaran and Rangachari, 1945)[8] abundant sources of genuine pectin are readily available.

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December 14, 1945.

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POTENCY OF INJECTABLE DIGITALIS PREPARATIONS

DIGITALIS as a useful cardiac tonic has been known in medicine for well over a century. In the form of a fresh infusion of its leaves and an alcoholic tincture which are both official in the British Pharmacopœia, Digitalis has been most frequently used by the oral route. In many cases of cardiac failure, however, absorption from the gastro-intestinal tract is very largely impaired. The need for an injectable Digitalis preparation, therefore, has always been felt.

"Unofficial" preparations available for this purpose are many, the commonest one being called "Digitalin". Nativelle[1] first introduced pure crystalline Digitalin in 1869. This was later proved to be identical with 'Digitoxin' $(C_{41}H_{64}O_{13})$. 'German' Digitalin is, however, not pure Digitoxin but probably a mixture of glycosides obtained from Digitalis seeds consisting largely of Digitonin, Digitoxin and other glycosides. 'French' Digitalin, also known as 'Homolle's Digitalin', is also reported to be a mixture of Digitanin, Digitoxin, and other glycosides. Each of these preparations and lately an American product claimed to be 'German Digitalin', have been used by manufacturers in India for the preparation of injectable products. There is also a feeling in the minds of the physicians that purified glycosides of Digitalis available in this form are less liable to deterioration, which is generally believed to occur with liquid preparation of Digitalis, such as the 'tincture' and the 'infusion'.

As part of our testing service on behalf of the Defence Department and the Director-General, Indian Medical Service, a study of the comparative potency of twelve imported samples of Digitalin was taken up in this Laboratory. The general characters, solubility, potency figures of these samples are given in the accompanying table. The bio-assay method followed was on guinea-pigs as previously recommended from this Laboratory (Bose and Mukerji, 1942).[2] The method briefly consisted of anæsthetizing the animal with intraperitoneal (1·8 gm./kg. weight) urethane, transfus-

Potency of samples in terms of Digitalis pulverta *B.P.**

Sample	Character	Solubility	Strength of solution in alcohol 10%	Mean lethal Dose c.c. kgm.	Potency Unit/ gramme of powder	Potency claimed Unit/ gramme of powder	Percentage of potency in terms of claimed potency
A	Slightly yellowish amorphous powder.	Sparingly soluble in water; soluble in alcohol, solution is clear.	1 in 1,000	23·82	47·39	80	59·2
B	Whitish amorphous powder with small lumps.	Very slightly soluble in water, soluble in alcohol, solution is clear.	1 in 1,000	14·95	75·51	80	94·4
C	Colourless, clear liquid of an agreeable aromatic odour with a bitter taste.	Freely miscible with water and alcohol.	1 in 8	14·25	0·63 (units/c.c.)	1·25 (units/c.c.)	50·4
D	White tablets.	Readily soluble in water and alcohol solution is clear.	1 in 1,000	13·50	83·62	80 (approx.)	104·5
E	White tablets.	Do.	1 in 1,000	28·60	39·47	80 (approx.)	49·3
F	Greenish hard mass.	Soluble in water and alcohol; solution is almost clear. (Slight haze.)	1 in 1,000	10·89	103·67	80	130·0
G	White tablets.	Readily soluble in water and alcohol, solution is clear.	1 in 1,000	19·00	59·38	80 (approx.)	74·2
H	Do.	Do.	1 in 1,000	12·77	88·40	80	110·5
I	Do.	Do.	1 in 1,000	11·67	96·70	80	120·0
J	Do.	Do.	1 in 1,000	12·07	93·50	80	116·8
K	Do.	Do.	1 in 1,000	17·13	65·89	80 (approx.)	82·4
L	Do	Do.	1 in 1,000	27·40	41·20	80 (approx.)	51·5

* The unitage has been calculated from the average lethal dose, 9.07 c.c. (1·129 units) kg. weight of guineapig, obtained by the authors with the standard digitalis tincture (1 in 80). B. P. C. Standard = 80 I.U. per gramme.

ing Digitalin solution (1 in 1,000) through the jugular vein at the rate of 0·5 c.c./min. till the cardiac pulsations were imperceptible. For each sample, at least six guinea-pigs were tried and the figures in the table represent the mean average m.l.d. figures. The standard deviation of these figures were determined by the usual formula and was found not to exceed 10 per cent. on either side.

It will be seen from the table that commercial preparations of Digitalin, even when stored in powder form in tropical climates, undergoes deterioration. While some figures indicate slightly higher potency than what is demanded by Digitalin, B.P.C. (*i.e.*, 80 units per gramme of powder), there are quite a number which are definitely below this level. This is undoubtedly, at least in part, due to hydrolysis of the glycosides, as it is well established that the aglycons are much less potent than the glycosides from which they are derived. This hydrolysis may be brought about by enzymes, which might remain in the Digitalin samples unless and until they are properly purified, a fact which is seldom achieved in most commercial samples of this category. From the point of view of medical practice, however, it may be a dangerous procedure to use under-strength Digitalin, which is used largely as an emergency measure in cardiac failure. It is, therefore, very desirable that all 'Digitalin preparations' must be biologically tested before they are permitted to be employed in the manufacture of injectable 'Digitalins' and similar preparations.

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1. Nativelle, Quoted by *U. S. Dispensatory*, 23rd. Edition, 1943, p. 369. 2. Bose and Mukerji, *I.J.M.R.*, **1942, 30,** 611.

CHARACTERISTICS OF INDIAN ANIMAL FATS

IVANOW[1] has shown that plants thriving in both hot and cold climates yield, when raised in the tropics, seed-fats that are relatively more saturated, since a certain effective degree of fluidity of the fat must be maintained relative to the environment. Animal fats—milk and depot—from tropical countries also appear to exhibit similar features of saturation. An analysis of 160 cow and buffalo milk fats by Achaya *et al*[2] revealed that the unsaturation varied from iodine value 24 to 40. The comparatively high saturation characterising these fats when compared to those of European origin, which give I.V. exceeding 40, is evident. Also, the I.V. of the cow ghees was about 3 units higher than buffalo ghees of the same R.M. value, there being an inverse relation between the two values in both species.[2]

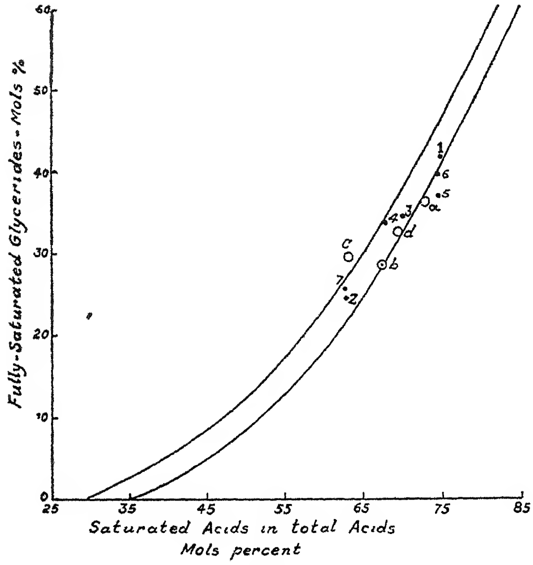
Since the neutral triglyceride component of blood is held to be the precursor of both milk and depot fats, the depot fats may in consequence be expected to reveal analogous differences in saturation. Four samples of Indian cow depot fats examined by Hilditch and Murti[3] showed extremely low I.V. (25·8 to 31·1) compared to Western beef tallows (I.V. about 40); while an analysis of four Indian buffalo depot fats by the authors showed I.V. between 23 and 27 which though too small in number in either case for an unqualified opinion, appear to be of the order of 3 units less as in the milk fats. The extreme saturation of these depot fats has been already noticed by Hilditch and Murti.[3]

In addition to these regional and species characteristics, there are striking peculiarities in the specific glyceride structures of Indian animal fats. Hilditch and co-workers[4] have shown that, if the fully-saturated glyceride percentage of animal fats be plotted against the percentage of total saturated acids of the fats, the points lie on a smooth curve which cuts the saturated acid axis at a point corresponding to about 30 per cent.—which is invariably the proportion of palmitic acid found in these fats, the percentages being about 23 ± 3 in the milk fats and 27 ± 3 in the depot fats. Corresponding points plotted for the fats from Indian animals lie rather on a fairly well-defined line about 4 unit mols. below the former. This new graph cuts the saturated acid axis at a point corresponding to about 35 mols. per cent., in striking agreement with the palmitic acid content of these fats; to make a further particularization, the percentages are about 27 ± 3 for the milk fats and 31 ± 3 for the depot. These relationships are shown below in tabular and graphical form :—

Observer	Total saturated acids (% mol.)	Fully-saturated glycerides (% mol.)	Palmitic acid content (% mol.)
Milk fats			
1. Buffalo Achaya and Banerjee [5]	74·9	41·7	31·9
2. ,, Achaya and Banerjee [5]	62·9	24·3	25·1
3. ,, Bhattacharya and Hilditch [6]	70·1	34·3	28·7
4. Cow Bhattacharya and Hilditch [6]	67·9	33·7	26·8
5. Sheep Dhingra [7]	74·6	36·8	20·4
6. Goat Dhingra [7]	74·6	39·3	21·5
7. Camel Dhingra [7]	62·6	25·6	28·3
Depot fats			
a. Cow Hilditch and Murti [3]	72·9	35·9	40·8
b. ,, Hilditch and Murti [3]	67·5	28·3	33·4
c. Goat Dhingra and Sharma [8]	63·1	29·2	27·0
d. Buffalo Achaya and Banerjee [9]	69·5	32·5	33·4

In addition to the above eleven cases worked out in full, data are available on the palmitic acid contents of three more buffalo milk fats,[5,6,10] and one more cow milk fat[6]; and of two cow depot fats,[3] one buffalo depot fat[9] and seven wild animal depot fats of Eastern animals.[11] These figures indeed strikingly confirm the new glyceride relationship postulated above which certainly appears more than coincidental.

Of the five apparent exceptions, the goat and sheep milk fats of Dhingra[7] were from animals on a winter diet in the Punjab and may indeed be said to support the contention that it is in a tropical climate that the above relationship



Comparative Glyceride Structures of Indian and Western Animal Fats

would hold; the low palmitic content of the buffalo milk fat (19·0) of Bhattacharya and Hilditch[6] and of the sacred baboon fat of Hilditch, Sime and Maddison[11] is no doubt due in the former case to unknown dietary factors, possibly cottonseed meal (*cf.* Achaya and Banerjee[5]), and in the latter to the high unsaturation of the fat and low content of total saturated acids. The reverse reason might also explain the high figure of 45·6 obtained by Achaya and Banerjee[9] in a buffalo depot fat of I.V. 23·8.

We wish to thank Prof. V. Subrahmanyan for his encouragement in the course of these investigations, which will be published elsewhere in full.

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January 7, 1946.

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ON THE PREPARATION AND COMPOSITION OF NEGATIVELY CHARGED FERRIC PHOSPHATE SOL AND GEL

THE sols and gels of various ferric salts have been described in previous communications to this *Journal*.[1] This paper records my results on the composition of negatively charged ferric phosphate sol and the preparation of the hydro-gel.

When potassium di-hydrogen phosphate is added to ferric chloride solution a yellowish white precipitate is obtained. It is observed that this precipitate of ferric phosphate can be dispersed by caustic soda or ammonia to give a bright red sol of ferric phosphate which bears a negative charge. The peptisation is greatly facilitated by the addition of glucose and glycerine. In a paper Mushran and Prakash[2] have studied the detailed conditions of the preparation of this sol.

The sol under investigation was prepared by mixing 40 c.c of ferric chloride (corresponding to 30·36 gms. of Fe_2O_3 per litre), 40 c.c. of 10 per cent. potassium dihidrogen phosphate solution, 20 c.c of glycerine and 80 c.c. N-NaOH solution. The total volume was raised to 200 c.c. The sol was dialysed for fifteen days.

The analysis of the coagulum of the sol obtained by the cataphoretic method indicated that the empirical formula of the suspension was 5 Fe_2O_3. 2 $FePO_4$. 11 H_2O.

The coagulum obtained from this sol by the use of electrolytes is gelatinous, but it could not set to a gel. I have obtained the gel, however, by the desiccation method. About 20 c.c. of the sol was allowed to evaporate slowly over concentrated sulphuric acid in a desiccator. After a week the sol was found to set to a transparent stiff jelly.

Further work on this sol and gel is in progress.

My thanks are due to Dr. Satya Prakash for his kind interest in this work.

Chemical Laboratory, S. P. MUSHRAN.
The University of Allahabad,
October 12, 1945..

1. Mushran., *Curr. Sci*, 1945, **14**, 123, 200, 233. 2. Mushran and Prakash., *Allahabad, Univ. Studies.*, 1943, **19**, 1.

STUDY OF THE COMPOSITION OF CHLOROMERCURIC ACIDS BY THE ELECTRICAL CONDUCTIVITY METHOD

THE electrical conductivity method of Dey and Bhattacharya[1] has been applied to the study of the chloromercuric acids and their potassium salts and the results are recorded in this note. The method consists in the measurement of the electrical conductivity of the individual solutions of chlorides and also of the mixtures of the mercuric chloride solution with varying concentrations of the hydrogen or potassium chloride solution. It was found that the mixture was more conducting than either constituent and the conductivity values were even greater than the sum of the conductivities of the constituents. In a graph the percentage

difference between the sum of the conductivities of the constituents and the observed conductivity of the mixture, is plotted against the concentration of the chloride solution. The graph gives a periodic curve with breaks corresponding to 1, 2 and 4 molecules of HCl for one molecule of $HgCl_2$. Thus the results afford the evidence for the presence of the following complex chloromercuric acids in a mixture of solutions of mercuric chloride and hydrochloric acid: $HHgCl_3$, H_2HgCl_4 and H_4HgCl_6. The corresponding potassium salts are also found to be present in a mixture of solutions of mercuric chloride and potassium chloride.

Detailed procedure with curves and the results will be published elsewhere.

I thank Dr. A. K. Bhattacharya for his helpful criticism and advice.

Department of Chemistry,
University of Allahabad, ARUN K. DEY.
October 12, 1945.

1. Dey and Bhattacharya *Curr. Sci.*, 1945, **14**, 69.

THE CYTOLOGY OF THE YEAST

THE striking advances in the realm of Cytology in recent years have unfortunately not embraced the industrially important micro-organisms, like yeast. The exact nature and behaviour of the nucleus in this important organism have remained more or less in the region of doubt.

A preliminary examination of smears of *Saccharomyces cerevisiæ* (?), fixed and stained accordance with well-known methods, has revealed the following features. Wort cultures of a certain strain of *Saccharomyces cervisiæ* were left for 24 hours after which the wort was renewed as it is well known that the organism goes into vigorous activity for a short period in the fresh wort. Smears were made during this short active span and fixed in Karpechenko's modified formula for Nawaschin, and in Levitski's mixture. The smears were then tested for the Feulgen's reaction after a mild acid hydrolysis. Individual cells show a clear cytoplasm enclosing a vacuole wherein are found one to about five Feulgen positive bodies (Figs. 1 to 5). These bodies are of varying sizes and shapes in adjacent cells and appear in different sites of the intra-nuclear vacuole. They represent portions of the nuclear material. Apparently these are regions with an excessive charge of nucleic acid and remind us of the heteropycnotic areas so well known in nuclei. The varying sizes and shapes which these bodies present under the influence of the same fixative should be sufficient caution against succumbing to the easy temptation of mistaking these for actual chromosomes.[1,2] This must be especially so in view of the fact that the dimensions of the chromosomes of an individual are genetically controlled.

Figs. 1 to 4 × 3600

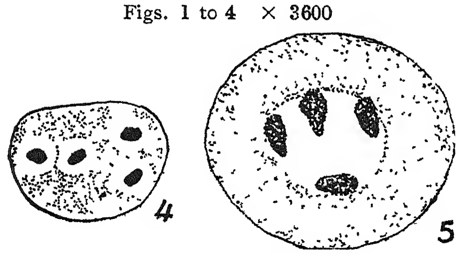

Fig. 5 × 4800

The fact that the nuclear material of the yeast gives a positive Feulgen reaction imports into the picture the validity of the time honoured concept regarding the type of nucleic acid here. The yeast nucleic acid is believed to be a pentose nucleotide not incorporating a desoxy sugar. Since the Feulgen test is specific for desoxy-pentose nucleic acid, it raises the important question whether all the *Zygosaccharomyces* contain the pentose nucleic acid which is Feulgen negative and stable to the action of the acids.

Further work is in progress.

Department of Botany,
Central College,
Bangalore, K. V. SRINATH.
January 7, 1946.

1. Badian, M., *Bull. Int. Akad. pol.* 1937, **B**, **1**. 1–5.
2. Subramaniam, M. K., and Ranganathan, B., *Curr. Sci.*, 1945, **14**, 78.

ASPARAGINE FROM INDIAN PULSES

l-ASPARGINE is a fine chemical in bacteriological and immunological routine; it provides an ideal source of organic nitrogen, readily assimilable by micro-organisms including yeasts. Considerable quantities of asparagine are employed in the production of tuberculin, diphtheria antitoxin, etc. Shortage of this fine chemical during war led us to investigate the possibility of preparing this chemical from indigenous sources. The four abundantly available pulses, green gram (*Phaseolus mungo*), black gram (*Phaseolus radiatus*), Bengal gram (*Cicer aritinum*), and horse-gram (*Dolichos biflorus*), have been studied for their capacity to yield asparagine on germination and growth. The method described by Vickery, Pucher and Deuber[1] has been closely followed in the preparation of etiolated seedlings.

EXPERIMENTAL

The seeds were steeped in running tap-water for 48 hours; after draining, the sprouting seeds were uniformly spread in trays furnished with fine wire-mesh and transferred to a cabinet provided with air-holes at the bottom and a flue at the top; this arrangement facilitated aeration of the growing seedlings. The seedlings grew in darkness, and were periodically sprayed with water. With a view to determine the day on which the maximum amount of asparagine was formed, the seed-

TABLE I

Analysis of Water-Soluble Nitrogen of the Extracts

Days	Green Gram Per 100 g of pulse				Black Gram Per 100 g pulse				Bengal Gram Per 100 g. pulse				Horse Gram Per 100 g of Pulse			
	Total Solids (gm.)	Total N (g.)	Amide N (g.)	Amide N as % of Total N	Total Solids (g.)	Total N (g.)	Amide N (g.)	Amide N as % Total N	Total solids (g.)	Total N (g.)	Amide N (g.)	Amide N as % of Total N	Total Solids (g.)	Total N (g.)	Amide N (g.)	Amide N as % of Total N
1	—	—	—	—	11·8	0·34	0·05	13·23	10·0	0·42	0·037	9·00	16·1	0·57	0·051	9·154
2	—	—	—	—	13·8	0·34	0·06	16·93	10·7	0·40	0·037	9·41	14·	0·63	0·102	16·04
3	19·3	1·48	0·03	3·89	12·9	0·54	0·07	13·86	10·3	0·41	0·041	10·03	13·1	0·82	0·162	19·55
4	25·0	1·67	0·15	9·27	24·7	1·04	0·14	13·11	9·0	0·41	0·052	12·53	21·0	1·25	0·240	19·63
5	19·9	1·80	0·33	18·18	25·6	1·31	0·17	13·27	10·4	0·53	0·093	18·20	22·3	1·58	0·333	21·60
6	16·0	1·67	0·61	36·08	27·4	1·74	0·28	15·90	12·5	0·59	0·131	10·0	20·80	1·58	0·370	23·36
7	15·9	2·13	0·68	31·92	22·5	1·80	0·40	21·21	12·6	0·73	0·155	21·32	20·0	1·53	0·435	27·48
8	14·3	2·1[illegible]	0·75	35·24	21·8	1·96	0·42	21·77	13·7	0·74	0·162	22·02	10·80	1·71	0·487	30·33
9	14·2	2·1[illegible]	0·79	37·27	20·9	2·02	0·50	25·12	13·2	0·75	0·150	25·02	21·4	1·08	0·501	25·54]

lings (200 in number) have sampled out at every 24 hours and immediately blanched in water kept vigorously boiling for this purpose; the treatment served to arrest the enzymatic activity of the tissues. The material was then ground up with water and extracted twice with water (by keeping on a boiling water-bath for 15 minutes). The combined extracts were acidified to pH 5·6, kept over-night, filtered and the filtrate made up to 500 c.c. Samples were treated in this manner for nine days and all the pulses were taken up for investigation. The resulting filtrates are analysed for (1) total solids by evaporation, (2) total nitrogen (by Kjeldahl) and (3) amide N as suggested by Jodidi and Kellogg.[2] The results of the analyses are embodied in the above table.

DISCUSSION

The results have been calculated as percentages on the weight of the seeds and are given in Table 1. It will be observed that (1) the percentage of water-extractable total solids rises in the earlier stages of growth and later tends to diminish, (2) a steady increase in the percentage of total and amide N in the extracts. Assuming that the amide N represents the asparagine content of the seedlings, it can be seen that of the pulses examined green gram (*Phaseolus mungo*) constitutes the richest source of asparagine. It should, however, be pointed out that the results indicate that by allowing the seedlings for longer periods, a further enrichment of the extract with respect to asparagine may be obtained.

M. R. RAGHAVENDRA RAO.
M. SREENIVASAYA.

Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
December 25, 1945.

1. Vickery, H. B., Pucher, G. W., and Deuber, C. G., *J. Biol. Chem.*, 1942, **145**, 45. 2. Jodidi, S. L., and Kellogg, E. H., *J. Agr. Reserch.*, 1918, **15**, 385.

WANTED A MUSEUM OF EVOLUTION

I HAVE read Mr. Randhawa's note entitled "Wanted a Museum of Evolution" in the November issue of *Current Science* with interest. This is a suggestion of far-reaching possibilities. Unless a deliberate attempt is made now by the leaders of public movement to wean the Indian mind from the futile ideological pursuits which pass under the name of religion, the state of "virtual civil war" between rival religious idealogies in this country will remain and perhaps increase in volume.

The best substitute for this so-called "religion" would be the right type of knowledge of fundamental facts of science, which, if imparted and diffused in the manner suggested by Mr. Randhawa, is sure to fertilise the mind of the average man, woman and child and lead it to constructive healthful pursuits. At present negative action and attitude of mind are rampant in many phases of our national life.

Of the branches of science none is likely to appeal more to our people than the science of Life-Biology, which comes nearest to their innate philosophical susceptibilities. Such "museums", after the first inevitable doubts and criticisms will soon become popular and unconsciously, in course of time, make people science-minded. A science-minded India will take its rightful place in the world more easily than the present ultra-religious minded population, seething with fissiparous tendencies and scenting danger to their faiths in all moves for common action or unity.

Ten lacs of rupees will give a fair number of such "museums" to our principal cities. The donor of this gift will give to India monuments more lasting and beneficial than any number of temples, mosques or churches.

D. N. WADIA.

New Delhi,
December 19, 1945.

REVIEWS

Frontiers in Cytochemistry. *Biological Symposia*, Vol. X. Edited by Normand L. Hoerr. (The Jacques Cattell Press, Lancaster, P.A.), 1943. Pp. viii + 334. Price $3.50.

Pupils of Professor Bensley, who had been inspired by his teachings and influenced by his pioneering work in the domain of cytochemistry, organised a symposium to celebrate his seventieth birthday; the theme of the symposium was to include his monumental researches which constituted his principal preoccupation during the preceding ten years—the physical and chemical organisation of the cytoplasm. The symposium was in all appropriateness, held at the University of Chicago—the scene of Prof. Bensley's activities. The proceedings of this symposium constitute the contents of the volume under review.

Discussions of thirteen different topics ably presented by his foremost associates covering most of the physical and chemical aspects of cytochemistry, are included in this volume. These are prefaced by a foreword by Normand L. Hoerr which gives a picturesque review of the highlights of Prof. Bensley's discoveries and experimental techniques; at the end of the volume, there is a reproduction of Professor Bensley's article on "The Chemistry of Cytoplasm" originally published in *Science*.

The conception of "Separating separable components of the cell first" before subjecting them to analysis, was first introduced by Prof. Bensley and methods of accomplishing this task through differential centrifugation Altman freeze-dehydration, and microincineration, were developed by his pupils.

Arnold Lazarow reviewing the chemical structure of cytoplasm as revealed by the work of the Bensley school, puts forward the concept that the cell is endowed with a structural organisation "which is due, in spite of a continuous aqueous phase, to an orientation of asymmetric micelles". The subject of cellular respiration which is a fundamental property of the living cell is presented by Guzman Barron from the view-point of the oxidation-reduction systems which participate in the reaction. Ultra-centrifugal studies on cytoplasmic components and inclusions are described by H. W. Beams, whose work in the field of the inexpensive and elegant air-driven ultracentrifuge, is well known. This article is well illustrated with revealing microphotographs lucidly reproduced. Albert Claude has contributed on the distribution of nucleic acids in the cell and the morphological constitution of cytoplasm. A further discussion on the application of the centrifuge in cell studies is given in this article. Experimental carcinogenesis in mice is the caption of an interesting contribution by E. V. Cowdry, in which the cell and nuclear volumes, mitotic frequency, nucleo-cytoplasmic ratios, response to colchicine, have all been described. The article by Isidore Gersh on histochemical analysis of changes in *Rhesus motoneurons* will be found interesting to those interested in the application of ultra-violet absorption microscopy to cytochemical problems. Of special interest to biochemists in general, are the articles on (1) macromolecular particles endowed with specific biological activity, and (2) fibrous nucleoproteins of chromatin which should prove particularly valuable to workers in the field of cytogenetics. Only a few of the points from a few of the articles contained in this exceedingly interesting and valuable collection, have been presented. The volume, which every cytochemist should own, is one which will inspire further lines of work and open out new vistas of thought and thus extend the frontiers of chemistry.

Advances in Protein Chemistry, Vol. I. Edited by M. L. Anson and John T. Edsall. (Academic Press Inc., New York), 1944. Pages xi + 341. Price $6.00.

Proteins constitute a naturally occurring and widely distributed group of fundamentally important compounds intimately associated with life and its processes; they play the vital role in the sustenance of life, in its propagation and in promoting the performance of all the functions characteristic of life. They have attracted the attention of several generations of investigators and there is scarcely any branch of science and hardly any experimental technique which has not been utilised to investigate the many-sided aspects of this fascinatingly complex and intriguingly elusive group of compounds. "The technique now used for the study of proteins range from the most elaborate form of X-ray analysis to quantitative measurements of antibodies. Workers in the most diverse fields of science have not only contributed to the development of techniques, but have become interested themselves in applying the techniques they helped to develop in the study of the problems of Protein Chemistry."

Proteins embrace the entire group of enzymes, some of the harmones, which regulate the processes of life, the viruses which afflict man, beast and plant and the chromosomes and the genes—the self-duplicating units of life and the carriers of heredity. In association with certain prosthetic groups, certain specific proteins acquire the power of a catalytic enzyme, an infective virus or a self-propogating gene.

In practical nutrition, curative immunology and preventive medicine proteins are indispensable and more recently they have invaded the field of technology. In view of the wide and varied interest bestowed upon the subject, the literature pertaining to it lie scattered over an ever-expanding field of literature. The need for periodical reviews on the various aspects of this subject has long been keenly felt and the series of publications heralded by the volume under review, is expected to fulfil an urgnt requirement in scienitfic literature.

It is a happy coincidence the year of publication of these *Advances* should have synchronised with the centenary of the discovery of nucleoproteins whose vital significance has subsequently been revealed. Eight reviews, covering mostly the fundamental aspects of protein chemistry, are included in the volume; Lipoproteins which are intimately associated with the structure and functions of the living cell, form the topic of a discussion by Erwin Chargaff. The isolation of these bodies, their physical, structural and antigenic properties are described. The second chapter is devoted to a discussion of the structural proteins of cells and tissues; the ultra-structure of the intracellular proteins as also that of the specific tissues, nerve, collagen, myosin and fibrin, as revealed by X-ray diffraction, electron microscope and polarised light, are given. The review on some contributions of immunology to the study of proteins will prove one of special interest to immunochemists.

The chapter on the purification and properties of protein represents an exceedingly well presented review which will repay a close study not only by investigators interested in a study of the hormonal proteins, their isolation, their purity and identity with the protein molecule or otherwise, also by enzyme chemists who are confronted with equally intriguing questions of purity, homogeneity and activity.

The masterly and critical presentation of our present knowledge relating to nucleoproteins by Jesse P. Greestein will be eagerly read by a large circle of investigators including those interested in cytogenetics. The article represents one of the most comprehensive reviews on the subject which have appeared in recent years. Keneth Bailey's review on the skeletal muscle gives a clear exposition of the subject which should prove equally valuable to biochemists and physiologists. The chapter pertaining to soyabean, we are afraid, presents a one-sided view of the problem; the facts and findings in this question have not been critically appraised; this is the impression which is created by a perusal of this review.

According to the enterprising editors, the second volume in the series will include a bunch of contributions which will "reflect the increased interest in protein nutrition stimulated by the war. These will include discussions of the estimation of amino-acids by chemical and bacterial growth methods, of the amino-acid content of protein foods, of protein nutrition in man and of the relation of protein nutrition to antibody formation". *Advances in Protein Chemistry* promise to constitute a valuable and stimulating series which would be eagerly welcomed by all interested in the fundamental and applied aspects of protein chemistry.

Dictionary of Metallography. By R. T. Rolfe. (Chapman & Hall, Ltd.), 1945. Pp. viii + 242. Price 15/-.

A treatise dealing with some particular branch of a technical subject is usually reviewed by someone expert in the appropriate field of knowledge. On the other hand any form of technical dictionary (and Mr. Rolfe's *A Dictionary of Metallography* is no exception) covers such a wide field of information that a comprehensive review is hardly possible by a single person and I must ask the reader to bear this limitation in mind.

It is my pleasant duty to record that a cursory reading of the book failed to reveal any of the gross errors which so often characterise works of this type.

Judging from items which deal with subjects with which I am conversant, Mr. Rolfe is up to date and accurate in his information. For example, it is refreshing to observe that the melting point of chromium is given at 1830° C. and not some value near 1500° C.—a figure quoted too often at the present day. Further, it is explained that the pure metal is reasonably soft and ductile and that the intense hardness usually encountered is due to the presence of carbide. The limits given for the phase fields in the high temperature region of the iron-carbon diagram are also in accordance with recent work carried out on high purity materials.

Reviewers sometimes draw attention to small discrepancies, if only to make it clear that they have read the book but Mr. Rolfe's dictionary does not give much scope for this form of activity.

Under the heading of "Electric Furnaces" and on page 71, reference is made to a spiral inductor coil which fits over a crucible. Strictly speaking, the coil is generally in the form of helix—although even here the author has some justification for whoever speaks of a helical staircase.

On page 60 the lower limit of the "delta" form of iron is stated as 1390° C., while on page 94 the older figure of 1404° C. is given for the gamma-delta transformation.

The author has accomplished the difficult task of condensing all the entries into the smallest compass compatible with clarity—with marked success.

In a dictionary the sins of omission can sometimes be greater than those of commission but *A Dictionary of Metallography* must be exempted from any criticism on this account. Altogether the little volume justifies both the established reputations of the author and publishers and my copy has at least one useful attribute—it stays open at any page.

FRANK ADCOCK.

Radio Receiver Design—*Part II. Audio Frequency Amplifiers, Television and Frequency Modulated Receiver Design.* By K. R. Sturley. (Chapman & Hall, Ltd., London, W.C. 2), 1945. Pp. 480. Price 28*sh.* net.

This book is in continuation of the author's *Radio Receiver Design*, Pt. I, and deals with the remaining stages of the radio receiver for amplitude-modulated signals as well as all stages of frequency-modulated and television receivers. This work, together with the previous one by an experienced radio engineer and writer like Dr. K. R. Sturley, is a true indication of the present position of radio receiver design.

The book is divided into eight chapters (numbered nine to sixteen chapters), the first

six of which relate to audio frequency amplifiers, power output stage, power supplies, automatic gain control, tuning controls and measurement of overall performance of radio receivers. The frequency-modulated and television receiver design is given in the last two chapters.

While no pain has been spared by the author in dealing with the topic under each of the first five chapters as thoroughly as possible and bringing it up to date, special mention may be made of the power supplies, automatic gain control and tuning controls which have been treated so well here but have not received adequate attention in other works on the same subject. The amplitude and phase discriminators have been dealt with exhaustively. It is, however, felt that the chapter on the "measurement of overall performance of the radio receivers" should have been more exhaustive. Topics like "random noise" and its measurement should have received more space.

The usefulness of the book has been considerably increased by the inclusion of the last two chapters on the design of frequency-modulated and television receivers which are at the present time, no less important than the amplitude-modulated receivers.

The book is packed with useful formulæ, graphs and figures which will prove extremely handy to the designer of radio receiver. The bibliography given at the end of each chapter includes the well-known papers on the subject which are quite useful to the reader. The printing and get-up of the book are excellent.

The reviewer warmly recommends this excellent work together with the previous one by the same author to radio receiver designers and engineers as well as to post-graduate and research students on the subject.

S. P. CHAKRAVARTI.

Selected Topics from Organic Chemistry. By D. D. Karve and G. D. Advani. (Dastane Brothers' Home Service, 456, Raviwar Peth, Poona 2.) Pages 284. Price Rs. 8.

Written on the lines of *Model Essays in Organic Chemistry* by the same authors,, the book under review contains thirty short chapters on the following topics in organic chemistry, *viz.*, Carbohydrates, Alcoholic Fermentation, Tannins and Related Products, Proteins and Polypeptides, Polymethylenes, Terpenes and Camphors, Natural and Artificial Rubber, Vegetable Alkaloids, Uric acid and other Purine Derivatives, Carotene and Flavones, Constitution of Chlorophyll, Anthocyanins, Synthetic Dyes and Drugs, Vitamins and Hormones, Structural Formula of Benzene, Substitution in the Benzene Ring, Electronic Formulæ of Organic Compounds, Relation between Colour and Chemical Constitution, Relation between Physical Properties and Chemical Constitution, Unsaturation, Organic Compounds containing Elements with Abnormal Valency, Catalysis, Oxidation, Reduction, Some Important Condensation Reactions, Stereochemistry, Tautomerism, Detection and Estimation of Groups, and Structure and Orientation of Organic Compounds. A set of questions and a bibliography are also included. Each chapter is a brief summary of the pertinent literature available in text-books and treatises presented in a form easily assimilable by and very helpful to students appearing for the first Degree Examination in chemistry. The material incorporated in the book covers much of the important section of the syllabus in organic chemistry for B.Sc. and B.Sc. (HONS.) courses. While the candidates must make use of standard works on higher Organic Chemistry as prime source of knowledge, the present volume should prove very useful to them as a handbook for "revision study" and as an "examination aid".

Although an 'Errata' slip has been included, there are still a few more printing errors. To cite a few: On page 59, line 1, "$\beta\beta$-diethylglutarate" should be "diethyl $\beta\beta$-dimethylglutarate"; on page 185,

$$\begin{array}{c}H\\|\\H-N-\\|\\N\end{array}\text{ should be }\begin{array}{c}H\\|\\H-N-;\\|\\N\end{array}$$

on page 238, in the formulaæ for $\beta\beta$-dimethylglutaric ester and diketo-cyclopentane-dicarboxylic ester, the central "-CH_2-" should be "-CMe_2-"; on page 239, line 11, "from" should be "form".

B. H. IYER.

The Indian Central Cotton Committee—Twenty-third Annual Report, 1944. Rs. 2.

The Report under review gives a summary of the research and other activities of the Committee for the year ending 31st August 1944. As such it does not take upon itself the onus of forecasting the future of the cotton crop in this country, especially now, when the second World War has come to a close. Serious attempts will have to be made to assure our farmers that the sweat and toil so intimately associated with men of their lot will not be in vain. As it stands, the layman feels that in the competition that is to inevitably arise between the artificial rayon and cotton, the former may emerge out as a victor though not a convincing victor, over the product of the earth. Still, two of the resolutions unanimously passed in the meetings held in 1944 clarify the position as regards an oncoming cotton crisis in the near future. The first resolution that "in the opinion of the Committee, resolute and determined steps should be taken at once effectively to stop the malpractice of mixing of cottons. The Committee accordingly authorises the local sub committee to go into the matter, take such action as it can and put up its final proposals for confirmation at the next monsoon meeting of the full Committee". The second important resolution on the question of the paramount urgency of growing more food is, "the Committee is convinced that the object in view can be achieved by improved methods of farming, suitable rotation of crops, and, above all, where conditions are favourable, by the introduction of mechanical devices for culture and harvesting operations. It accordingly requests the Government of India to give immediate facilities for manufacture in the country and import from abroad (to meet immediate requirements) of improved implements and machinery and fertilizers".

The first of the above resolutions demands very serious consideration. The question is whether the enforcement of law by legislation would be feasible in a matter of the gravest importance as that of mixing of short and long staple cotton in factories. The answer is that one has to be sceptic about this approach with existing conditions. It might be more readily practicable if this malpractice and its ultimate repercussions be given the widest publicity throughout the cotton-growing tracts which might in turn ultimately educate the masses. The second resolution mentioned above is again only a recommendation. It is intimately linked up with policies of a far-reaching nature, namely, the industrial development of this country. There is hardly any need for the reviewer to point out that it needs a very bold agricultural policy on a national scale to make this resolution a success, as for instance, we are told, has been the good fortune of the Russian peasant.

In addition to the above points, the reviewer was attracted by the reference made by the Cotton Committee on the severe hardship to the cotton cultivators by the lowering of the floor and ceiling prices. This resolution, although giving a true picture of the heavy suffering the farmer toils under, may not straightaway relax his difficulties. Nevertheless one must appreciate the standpoint taken by the Committee and wish that their efforts are crowned with success.

The rest of the Report deals with the progress of various researches underway in the country. The Cotton Committee certainly demands our praise at the very varied services it is rendering to the cause of cotton in India but apart from its excellent seed distribution and other schemes it may be worthwhile extending its finances to Universities for fundamental researches on the nutritional physiology of the cotton. For work of this type, quite a large number of University Departments are ideally equipped. A central scheme for co-ordination on these fundamental problems can be chalked out and immense quantity of valuable data collected if problems are distributed to various Universities and run on proper lines. It would be difficult to deal with the various aspects of the subject-matter presented in the Report under review and the reviewer wishes to point out that for any one interested in the latest position as regards cotton-growing in India, this Report would be indispensable.

T. S. SADASIVAN.

SCIENCE NOTES AND NEWS

Lady Tata Memorial Trust: Scientific Research Scholarships, 1946-47.—The Trustees of the Lady Tata Memorial Trust are offering ten Scientific Research Scholarships of Rs. 150 each per month for the year 1946-47 commencing from 1-7-1946. *Applicants must be of Indian Nationality and Graduates in Medicine or Science of a recognised University. The Scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of the head of a recognised research institute or laboratory.* The subject of scientific investigation must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applicants are required to furnish the following information in their applications along with certificates of physical fitness and character:—

(*a*) Full name, (*b*) Age, (*c*) Sex, (*d*) Permanent address, (*e*) Details of academic career (*f*) Particulars of previous research work, (*g*) Particulars of the proposed research, and (*h*) *Particulars of other emoluments, scholarships and pay or any other financial support from friends or relations they are or will be in receipt of during the period they are Scholars.*

In stating the particulars of the proposed research under (*g*) applicants must give (*a*) a short resume on the subject of research indicating the present state of knowledge and (*b*) details of the proposed research indicating (*i*) the methods intended to be employed, (*ii*) previous experience in the use of these methods and (*iii*) the experiments to be carried out.

Applications must be forwarded through the Director of a recognised Research Institute or Laboratory where the applicant proposes to work and must be accompanied by a letter from the Director or Head of the Department concerned stating that he has critically examined the details of the proposed research, that he approves of the general plan and that he is willing, as far as possible, to guide and direct the investigation and give laboratory facilities.

Applications, which must be typed, must give full particulars in the order indicated above and must be addressed to the Secretary, The Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay, so as to reach him not later than 15th March 1946.

Journal of Colloid Science.—The Academic Press, Inc., New York 10, N.Y., have announced that the first issue of this new bi-monthly is scheduled to be published in January 1946. The *Journal* is priced at 10 dollars a year. We have no doubt that the publication, which is the first of its kind in the English language, will receive world-wide welcome, both from scientists and technologists.

Dr. U. N. Chatterji, M.Sc., D.Phil., officiating Editor of Journals, Imperial Council of Agricultural Research, New Delhi, has received the D.Sc. degree of the University of Allahabad for his thesis on "Physiological studies on some intermediate steps in plant respiration".

Mr. Sukhsampttirai Bhandari, M.R.A.S., Author and Publisher, Dictionary Publishing House, Brahmpuri, Ajmer, has announced the publication of three volumes of *20th Century English-Hindi Dictionary of Scientific and Technical Terms.* This appears to be the first work of its kind in Hindi.

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OVERSEAS TRAINING OF TECHNICAL PERSONNEL

EARLY in October 1944, Sir Ardeshir Dalal, the then Member in Charge of the Department of Planning and Development, sponsored a scheme for sending students abroad for advanced studies in the United Kingdom and the United States of America; the scheme was intended to increase the supply of competent technical personnel needed in connection with the realisation of the plans for post-war development. The selection of the first batch of students has been completed; according to the report of the Overseas Scholarship Selection Board, recently published by the Government of India, 8,835 applications were considered and 354 candidates were finally selected after interviewing 444 applicants. These figures do not include the scholars interviewed and selected by the Provincial Governments and the Indian States. The total figure, however, exceeds 700. While a good proportion of them have already reached their destination, a considerable number of students are still to embark on account of lack of passage and on account of the uncertainty of admission into the American and British Universities and Research Institutes. In the meanwhile, the Central Government have invited applications for the award of foreign scholarships in 1946-47; the brochure which has been issued for the information of the applicants declares that "arrangements for instruction will be made primarily in the United Kingdom and the U.S.A. but, provided that satisfactory arrangements can be made, in other countries also, such as Australia, Canada and New Zealand".

It will be admitted that the "arrangements for instruction" made for the benefit of the preceding batch have not been as satisfactory as one would wish. Reports of dissatisfaction at the standard of facilities and opportunities for study offered by some of the centres of learning, have reached this country. It is particularly painful that such reports should have come from students who have chosen to study in the United Kingdom. Students who have been deputed to England represent some of the best judged by the highest standards of academic distinction and intellectual attainment; some of them have had training in research and have shown special aptitude for a career of scientific research. It would be tragic if such students should be denied the best opportunities for training which British Universities and Research Institutes could offer.

Professor A. V. Hill, in his report on Scientific Research in India, had already warned that the British Universities, during the post-war period, would become crowded; the British had to face their own problems of Scientific and Technological Education and Reconstruction. Six years of the terrible war, punctuated with anxious months of blitzing, had created a distressing deficit in the supply of scientific personnel. The resources of their

foremost Universities and Institutes will naturally be mobilised to make up this deficit. The paralysation of the German centres of Science and Technology which used to attract a large number of European and Indian students, imposes a further strain on the British Universities.

American Universities have to meet similar responsibilities, although their problems are not so acute nor so distressing. Dr. Vannevar Bush, in his report to the President, *Science, the Endless Frontier*, points out that "the deficit of science and technology students, who, but for the war, would have received bachelor's degrees in these fields will amount in 1955 to about 17,000, for it takes six years from college entry to achieve a doctor's degree of its equivalent in science or engineering". But the resources of the American Universities and Research Institutes are immense and they are, therefore, in a position not only to solve their problems of deficit in scientific talent but to welcome foreign scholars for training. Thanks to a variety of factors and a complexity of circumstances, particularly the exodus of the eminent men of science and technology from Europe and the lavish Governmental support extended to the wartime research, the American Universities and Research Institutes have attained a position of unchallenged pre eminence. A good proportion of our scholars for some years to come will no doubt choose to draw inspiration from the American centres of learning.

In view of the difficulty for admission to the first rank centres of learning in the United Kingdom and America, the Government of India are trying to make arrangements in other countries like Australia, Canada and New Zealand. This is very good more so far as it goes. There are, however, other countries beyond the orbit of the British Commonwealth, which might be seriously and advantageously thought of, we mean particularly Russia, Sweden and Denmark. These countries have made great headway in certain fields of science and technology, and in certain branches, they represent the only centres in the world where proper and adequate instruction can be had. Difficulties due to language, which might perhaps be raised in the case of Russia, need not be considered very serious since Indian students, unlike the English, have a genius for mastering languages; have not scores of Indians gone to German Universities for training? So long as we must, we should help our young men to seek admission into the foremost seats of learning in the world, irrespective of political barriers and nationalities We earnestly hope that the Central Government will seriously take into consideration the advisability of exploring the great and fruitful possibility of deputing a good proportion of our scholars to Russia and the Scandinavian countries.

PALUDRINE (M. 4888)—A NEW DRUG IN MALARIA*

RESULTS of experiments with Paludrine have been announced as the most potent anti-malarial drug known. The drug has been thoroughly tested in 200 cases of malaria amongst Australian soldiers, who volunteered as patients at a medical research unit at Cairns, North Queensland. Brigadier N. Hamilton Fairley was in charge of the experiments, assisted by a large team of research workers, including physicians, pathologists and entomologists.

It has been claimed that this new drug is much more effective than either quinine or atebrin. Paludrine produces radical or permanent cure in the dangerous malignant type of malaria. The percentage of cure in the benign tertian malaria is not yet known and it is too early to assess its value in this type of infection; but the results of observation at Cairns suggest that one or two tablets (each 0·1 gm.) taken each week end would give complete freedom from attack and would probably control relapses indefinitely until cure was attained.

In malignant malaria paludrine has been found to destroy the parasites inoculated by the infected mosquitoes at an early stage of their development. In consequence the parasite never gains access to the blood circulation. If three tablets of paludrine are taken three hours before the volunteer is bitten by heavily infected mosquitoes, malignant tertian malaria does not occur. This definitely proves that paludrine is a true phophylactic. Similarly, if volunteers taking one tablet daily, be bitten by mosquitoes infected with benign tertian malaria, they fail to develop symptoms of malaria or to show any malarial parasites in the blood while paludrine is being taken.

A remarkable feature of this drug is the smallness of the dose required to control an attack of malaria—0·1 gm. only has proved sufficient to end an attack and bring temperature to normal in both benign tertian and malignant tertian types of malaria. Nothing like this can be achieved by either quinine or atebrin.

The potentialities of this new drug has not yet been thoroughly explored, but from the recent reports there is every reason to believe that an important new discovery has been made, which will open up a new vista in the chemotherapy of malaria.

N. N. De.

* Abstracted from Release No. P. 255 of Public Relation Officer, Australian High Commissioner's Office, 7, Metcalfe Road, Delhi.

THE ELECTRONIC THEORY OF VALENCY*

THE remark of Sir J. J. Thomson while opening a discussion on the subject at the Faraday Society in 1923, "The electron dominates the field of chemistry", is true even now, though our approach to the problems are somewhat different to-day. A satisfactory theory has to take into account not only the possible stable molecular forms but also the means of attaining the requisite configuration while ordinarily valence theory takes note of only the former.

The electronic theory of valency begins with the publications of Lewis and of Kossel and using a static model of the atom Lewis was able to explain a whole lot of chemical facts. By the time these were reconciled with the dynamic model of Rutherford and Bohr with Lewis's postulate, "an orbit as a whole, and not the electron in some one position within the orbit, is the building stone of atomic and molecular structure" one had to reckon with the upheaval caused by the new quantum theory. Chemists have been accustomed to classify bonds into various types: ionic, homopolar, semipolar and metallic, in the interpretation of each of which the quantum theory has been used. The present report deals with this new development. These classifications can be regarded at best as a useful guiding principle, the concept of valency itself being essentially vague. The concept and the classification can best be regarded as a convenient simple picture of the fundamental energy relationships on which molecular architecture is based.

In tackling the problem of molecule building with known atomic structural units, the principal difficulty facing the investigator has been mathematical and approximations were, therefore, inevitable. We have two different modes of approach: the method of molecular orbitals developed essentially by Lennard Jones, Hund and Mulliken and the method of localised electron-pairs or the H-L-S-P method. Lewis's concept of the ionic bond is essentially valid even now while the interpretation of the metallic bond is a triumph of the new quantum theory but the covalent or homopolar bond is the one that has brought out the limitations of either method of approach.

When atoms are brought together, the interatomic interactions may be expected to appreciably modify the atomic wave functions but as a first approximation, one can treat these as remaining unchanged. This assumption is implicit in both the methods. The energy of a molecule can be expressed as a sum of Coulomb integrals involving atomic wave functions and exchange integrals involving electrostatic interactions of electrons and nuclei. In choosing the atomic wave functions, the ground state is not the only one to be considered. For instance, in the formation of hydrogen from the atoms, kinetic studies have shown that the formation of the molecule involves a three body collision in which the third body takes away the excess energy liberated in the reaction. In interpreting the interaction one has to visualise a non-classical effect whereby a strong attraction is followed by a repulsion, an equilibrium corresponding to molecule formation being obtained. For a stable bond between the atoms, the two electrons taking part must combine so that the resultant spin becomes zero, the bond energy being the sum of the two types mentioned earlier. The initial success of the Heitler-London method with hydrogen led to a rapid though incomplete development of the theory to the interaction of atoms with several electrons with more than one unpaired. In these applications, one has often to consider excited states of the atom in addition to the ground state. Combining these ideas with a consideration of electron density distribution in space, Pauling and Slater have devised a theory of directed valence forces consistent with the known stereo-chemistry of carbon compounds.

A normal carbon atom has the arrangement of electrons $1s^2$, $2s^2$, $2p^2$ and the normal state is $^3P_0$ with the slightly higher ^1S and ^1D. Assuming the wave functions of an electron to be separable and factorised into radial and orientational factors, the $2p$ electrons must differ in their orientational part. With two such unpaired electrons, two stable bond pairs can be formed. Four bonds can, however, be formed by the excited ^5S state of carbon with the configuration $1s^2$, $2s^1$, $2p^3$. In all cases where bond energy exceeds a value of 1·6 volts (the difference between the two states of carbon), one can reasonably assume the participation of this state and most organic compounds happen to belong to this category. Using the ^3P and ^1D states it is possible to construct a divalent carbon atom, but a tetravalent carbon atom requires four electrons, each independent and in a singly occupied orbit. An sp^3 configuration enables the construction of four independent orbits. Three mutually perpendicular p electrons and a spherically distributed s electron with the mutual repulsive forces of the hydrogen nuclei can lead to a tetrahedral form for the methane molecule, but this would imply one carbon-hydrogen bond different from others, which is contrary to known experimental evidence. Now any suitable wave function must satisfy the conditions that the orbits must be mutually orthological and have the aggregate configuration $2s2p^3$. Pauling has shown that both these and the equivalence of the C-H bonds in methane, satisfied by using the concept of sp hybridisation. *The use of hybrid bond orbital functions is an essentially empirical approach* that has been justified by its successful interpretation of phenomena in organic and inorganic chemistry. This hybridisation, by introducing the $2s$ wave functions in the compound orbital functions is considered possible only if the energy of the $2s$ state is not very different from that of the $2p$.

Mention should be made at this stage of a fundamental principle of quantum mechanics used in chemical applications and underlying

* Proceedings of a Symposium held on the subject at the Annual Meeting of the Indian Academy of Sciences, at Udaipur, Dec. 1945.

the concept of 'resonance'. Any structure representing a system corresponds to a wave function ψ and the energy value calculated using the correct wave function ψ_0 is lower than that calculated using any other wave function ψ. If there are several structures that might conceivably represent the normal state of the system, a general function of the form

$$\psi = a\,\psi_{\text{I}} + b\,\psi_{\text{II}} + c\,\psi_{\text{III}} + \cdots\cdots + n\,\psi_{\text{N}}$$

can be obtained. The best relative values of the coefficients are obtained by making the energy value a minimum. The structure of such a system is *not intermediate between the various forms* but the normal state is described as *involving all structures in resonance*. As a consequence of this, the system is stabilised by an amount of energy, 'the resonance energy'. There is a certain amount of arbitrariness in the concept of resonance but this is to some extent offset by the convenience and value in its chemical applications.

The concept of resonance is common to both methods of treating valence problems. In the HLSP method, the contribution of ionic terms corresponding to both the electrons being with the same nucleus is not given adequate emphasis and the expression for the total energy of a system does not take into account the effects due to the Pauli exclusion principle. In the method of molecular orbitals both these are taken note of with a possible overemphasis of ionic terms. The wave function expresses the motion of an electron in the resultant field from all the nuclei and the other electrons in the system. For a diatomic molecule the theory is essentially a discussion of the quantum numbers of electrons in an axially symmetrical field. Mulliken observed that extension to a polyatomic system resolves itself into a question of determining the behaviour of various atomic orbitals conforming to the symmetry of the system.

The position is analogous to conditions pertaining to the movement of an ion in the field of other ions. While it is difficult to say categorically whether the method of molecular orbitals or the HLSP method is the better approximation, the molecular orbital methods are more convenient for qualitative discussion but the HLSP method has been more often used for quantitative calculations.

Among the useful results obtained by Pauling's interpretation of the chemical bond, bond energy, bond length, bond order and partial ionic character of covalent bonds constitute a fundamental departure from earlier approaches to the subject. The method has been remarkably successful in the study of organic compounds but one has to guard against an overemphasis of the findings of such analysis. Both the electronegativity scale and bond energy relationships are essentially empirical. In deriving bond energy values, Pauling uses the postulate of the additivity of normal covalent bonds and where this fails, the postulate of the geometrc mean. Pauling himself remarks, "It is probable that in general, the postulate of the geometric mean leads to somewhat more satisfactory values than the postulate of additivity for normal covalent bonds between unlike atoms, ... We shall find it *convenient* to make some use of the postulate of additivity as well as the postulate of the geometric mean" (*italics mine*). From single bond energy values determined by an analysis of thermochemical data complete electronegativity scale has been built up, and in a very large number of cases the values thus obtained are proportional to the sum of the first ionisation energy and the electron affinity of the atom. Where atoms are linked together by single bonds, the bond moments are found to be related to the difference in their electronegativities. There are, however, significant exceptions. On the basis of the electronegativity scale the carbon-iodine bond cannot have any significant amount of ionic character, and hence should have zero moment, but is found to have the same bond moment as other carbon-halogen bonds. The phosphorus-hydrogen bond is another instance where the correlation breaks down. With such exceptions, one has to view with some circumspection conclusions on the partial covalent character of bonds in ionic crystals, unless some more unequivocal evidence is forthcoming.

The correlation of bond distance and bond order is on a somewhat better footing. If the potential function of the resonating bond be represented as the sum of two parabolic functions involving the single and double bond potential functions, an expression of the type

$$V(R) = \tfrac{1}{2}(l-x)\,k_1(R-R_1)^2 + \tfrac{1}{2}\,x\,k_2\,(R-R_2)^2$$

is obtained. The derivative of this with respect to R equated to zero for the equilibrium order and the force constants. If k_2/k_1 is taken as 3, one gets

$$R = R_1 - (R_1 - R_2)\,\frac{3x}{2x+1}$$

The curve corresponding to this equation agrees very well with the experimental values for carbon-carbon bonds and with a change of scale for other bonds as well. The force constant ratio, however, is more than that of any known instance and Pauling attributes this discrepancy to the neglect of resonance energy in the assumed potential function. Using the observed constancy in the carbon-carbon single-bond distance in the saturated hydrocarbons and in diamond, this concept of bond order has enabled the interpretation of conjugated systems and the phenomenon of hyperconjugation.

The concept of resonance has also been used in the interpretation of the aromatic compounds and their reactivity together with a plausible explanation for the existence and stability of free radicals. Another important application of these concepts is provided by structures involving hydrogen bonds without the necessity of postulating a covalency of two for hydrogen.

An important extension of the same principles of hybrid bond orbital functions is in the interpretation of the complex compounds of the transition elements. Notable examples are provided by the metal carbonyls, and the cyanide complexes in which the metal carbon bonds are much shorter than could be accounted for with a single bond while the carbon-oxygen and carbon-nitrogen bonds turn out to be longer than required by a triple bond.

Mention should be made here of the different significance to be attached to the term 'co-ordination'. The classical chemical concept couples this with the donor-acceptor properties of atoms or ions. In the interpretation of ionic crystals and in the metal complexes we notice a different meaning. As with other bonds, co-ordination also involves both covalent and ionic types.

A logical extension of the resonance concept is the interpretation of the transition-complex in a chemical transformation as a system in which the extreme degenerate structures are the reactants and the products. Polanyi and co-workers have been able to successfully interpret the substitution reactions of alkyl halides on this concept and one may naturally expect more developments on these lines.

In the discussion that followed, Sir C. V. Raman drew attention to the observations of Mr. G. N. Ramachandran on the fluorescence spectrum of the diamond which appeared to go against the whole concept of hybridisation as interpretation of the results was possible by assuming the existence of carbon atoms in the ground state alone in the diamond molecule. Against this it was pointed out that the mass of chemical facts that required the concept for a proper interpretation and the possibility of the selection rules having to be different with hybrid bonds could account for any apparent discrepancy.

Dr. Nagendra Nath gave an ingenious picture of bond formation between carbon atoms (*single bonds only*) without any hybridisation involving the 2*s* electrons of one atom and the 2*p* electrons of the other by an extension of the Hietler-London treatment of hydrogen molecule. In order to satisfy the requirements of spin, it was assumed that the paired electrons got unpaired before bond formation. Using this picture he was able to account for the four forms of diamond. In the course of the discussion, Dr. Nagendra Nath said that no attempt has been made by him to interpret multiple bonds nor the case of bonds between different atoms. Even with regard to the particular bond in question one has to await fuller details before accepting or rejecting the interpretation.

Dr. G. V. L. N. Murti gave a brief account of the application of Raman spectra to interpret hydrogen bonding. Prof. K. S. Krishnan, the Chairman of the Symposium, Prof. Bhagavantam and others took part in the lively discussion that followed.

S. V. ANANTHAKRISHNAN.

CHEMISTRY AND PHARMACY*

IN the course of his Presidential Address to the Sixth Session of the All-India Pharmaceutical Conference held in Bangalore during the first week of January 1946, Sir S. S. Bhatnagar said:—

"A nation that merely follows the example of other nations, howsoever great it may become, can never lead. Industry will really flourish only in those countries which are able to produce quality goods of an original character. We should, therefore, cease to quarrel over trivial issues such as the relative importance of pure and applied sciences and get to brass tacks, particularly as there is no line of demarcation between the two so far as your own science is concerned. Not long ago, chemistry was entirely pharmacy and pharmaceutical chemistry, and all chemists of any note were really pharmaceutical chemists. The interesting fact is that in your domain, it was the applied science that gave birth to the science of pure chemistry. With the rapid growth of pure science, the relative importance of the two may have changed. Nevertheless, the fact remains that pure chemistry is a child of pharmaceutical chemistry and howsoever much the pure chemist may look down upon a pharmacist or a pharmaceutical chemist, he has to admit that pharmaceutical chemistry provided him with excellent ancestry. The most recent achievements of the chemist which have resulted in the development of such medicinal substances as penicillin, D.D.T., streptomycin, gammexane and several new sulpha drugs seem to show that pharmaceutical chemistry experienced a specially virulent growth during the fateful years of this war. Nobody connected with researches on these important subjects can be branded as a mere druggist and assigned to a lower order of scientific achievement. However, in order to raise your status in international science, the pharmaceutical chemists and the pharmacologists and the medical men amongst you, must concentrate on high class research work. That India has the necessary talent to make contributions of great importance in these subjects can be gathered from the fact that several outstanding discoveries have been made in the past in this country. For example, after the brilliant discovery of Chistina and Caronia that tartar emetic was useful in the treatment of infantile kala-azar of the Mediterranean basin, Rogers in India introduced the use of tartar emetic intravenous for the treatment of Indian kala-azar. Soon after this, Sir U. N. Brahmachari introduced the use of sodium antimonyl tartarate for the treatment of the disease; subsequently his name as the discoverer of urea stibamine, a cure for kala-azar, became well known far and wide, as this drug above all others has helped greatly in the conquest of kala-azar in India. The drug industry which followed in the wake of Sir U. N. Brahmachari's discovery, is India's very own and will long remain hers as both the discovery of the cure and manufacture of urea stibamine were results of indigenous talent. Mention must also be made here of researches carried out by

* Extracts from Sir S. S. Bhatnagar's Presidential Address to the Sixth All-India Pharmaceutical Conference, Bangalore.

Col. Sir Ram Nath Chopra and his colleagues which have helped the industry and pharmaceutical research.

"The scope for a really great pharmaceutical industry in this country is, however, intimately connected with research work in chemistry, in physics, in biology, in nutrition, in pharmacology and in clinical medicine. I claim to be no prophet but I feel that a pharmaceutical industry is bound to follow in the wake of the proposed basic chemical industry in this country. We can, however, hold our own against the competition which is sure to follow only if we have new drugs, new processes, new methods of cure and brilliant research work to our credit which we may claim as our own. This is the new outlook which is engaging the attention of U.K., U.S.A. and U.S.S.R. to-day. The greatest asset to a nation is not gold, but an original mind. We have not the gold, and although it does not necessarily follow from this that we have an excess of original mindedness in this country, I hope I am right if I make bold to say that the original mind is not such a rarity in India as gold, although both may require to be dug out.

"The pharmacist who does not believe in research is lowering the status of his profession. On the other hand, the pharmacist who conducts research or is research-minded establishes those contacts with research workers in pure science and medicine which entitles him to respect amongst scientific workers. To-day the science of pharmacy must look to all sciences for the increase and expansion of its scope, as the instruments and materials which help in the eradication of disease are spread over many fields of study. Whilst organic chemistry is still, and will long continue to be, the fundamental branch of chmistry which the pharmacist and the pharmaceutical chemist must know, colloids, inorganic substances, radiations and tracer elements are being increasingly employed by medical men, and the future pharmacists will have to be proficient not only in organic chemistry, but also in nuclear physics, nuclear chemistry and in medicine and biology.

"The trend of research in the fields connected with your Association's activities in international science shows that subjects which have attracted the greatest attention are (1) Chemotherapy, (2) Antibiotics, (3) Hormones and Vitamins and (4) the rapidly developing subject of Biophysics.

Chemotherapy and Antibiotics

"In the field of chemotherapy, after the classical work of Ehrlich and the synthesis of such drugs as salvarsan, the discovery of atebrin, plasmoquin and germanin were epoch-making, but they were completely eclipsed by the revolutionary synthesis of prontosil by Mietzsch and Klarer and the demonstration of its therapeutic properties by Domagk in 1937. Following upon this discovery, no less than 5,000 new sulphur compounds have been synthesized and examined, and from this colossal effort in the world's laboratories at least five compounds of supreme importance have emerged—sulphaacetamide, sulphadiazine, sulphaguanidine, sulphapyridine and sulphathiazole, which have become *official* in the British Pharmacopæia. The production of sulpha drugs reached a peak in 1943 when in U.S.A. alone, above ten million pounds were produced.

"In 1941 with the discovery of penicillin by Fleming and Florey, the interest has shifted to compounds produced by the micro-organisms themselves. Compounds such as patulin, vivicillin, gliotoxin and helvolic acid have been discovered, some of these poorer than penicillin in antibiotic properties, others very much better though more toxic to the human organism. This vast field is, however, just beginning to be explored and its full potentialities are yet unknown.

"After the structure of these compounds becomes known, a new field for the synthetic organic chemist will be opened up and it will be no wonder, just as the simple synthetic methyl-naphthaquinone proved to be more active than the naturally occurring vitamins K_1 and K_2, a simpler synthetic compound may be discovered far more active in antibiotic properties and less toxic or less readily excreted, than penicillin or any of the natural compounds.

Vitamins

"In the fascinating field of vitamins the most significant advance has been made in the discovery of the factors within the fold of the B_2 complex. Factors such as pyridoxin, pantothenic acid, biotin and folic acid have been isolated in a pure form and are being made on a large scale. Of these, folic acid seems to be most interesting and appears to be identical with the grass juice factor of Elvehjem. Even such simple compounds as choline, inositol, p-amino benzoic acid have been found to possess the properties of vitamins. New vitamins continue to be discovered such as B_{10} and B_{11} from the Wisconsin Laboratories. Substances known as antivitamins have been recognised and a maze of inter-relationships of the different vitamins such as was recognised in the case of hormones has been brought to light. A still more signal achievement is the synthetic production by tons of the well-known vitamins such as thiamin, ribo-flavin, nicotinic acid and ascorbic acid, making them available to the common man in the form of multi-vitamin tablets at a cost of not above two pice per head per day, and making possible the large-scale fortification of white flour and other common foods on a nation-wide basis. Even in this field large potentialities remain unexplored. While the majority of nutritionists continue to think in terms of the fight against malnutrition and deficiency diseases widespread in all countries, those in the vanguard of this research have been trying to find out what happens in the exceedingly mild forms of deficiency. Wilder from the Mayo Clinic has reported that in the early stages of vitamin deficiency the subject becomes depressed, irritable, quarrelsome, unco-operative and fearful. Such nervous conditions were associated with hormone metabolism and now we know that even dietary factors play a part in the mental make-up of man. As such it touches every living man, woman or child and shows the possibilities that lie ahead in the applied field.

THE AUTONOMIC NERVOUS SYSTEM AND THE HYPOTHALAMUS*

DURING recent years much research has been carried out on the autonomic nervous system and an account of the various influences that this system exerts upon the body and on the numerous functions of the hypothalamus so far as they are connected with this system, is very interesting. Prof. De, in his Presidential Address, deals only with a few of the more important functions which are under the control of the hypothalamus. He has traced the history of the development of the knowledge of the sympathetic nervous system as far back as 1727, when du Petit first suggested the autonomy of the sympathetic nervous system. Jacque Benigne Winslow introduced the term "sympathetic" and the term "vegetative nervous system" was first used in 1880 by Marie Bichat. There has been some difference of opinion regarding the interdependence of these two systems. Towards the end of the last and the beginning of the present century new light has been thrown by the work of Langley and his school and the work of Gaskell on the vegetative nervous system. Gaskell demonstrated the connection of the sympathetic peripheral mechanism with the central apparatus and with the nerve cells in the spinal cord and pons. The presence of synapses in the path of the fibres was first revealed by Langley. Every fibre of the sympathetic system forms one synapse with a nerve cell at some point in its course and this is the only break in the continuity of the fibre. Each fibre path is composed of two sections—the pre-ganglionic and the post-ganglionic. The name "autonomic nervous system" was given to this system by Langley who divided the whole system into tectal, bulbosacral, thoracio-lumbar and enteric. The tectal and the bulbosacral outflows were grouped by him as "parasympathetic" and thoracico-lumbar as "sympathetic". Langley noted the antagonism between the sympathetic and the parasympathetic systems. The sympathetic system is catabolic and the parasympathetic system is anabolic. A delicately balanced co-ordination of the sympathetic and the parasympathetic activities is required to maintain the uniformity of the conditions of the body.

Prof. De then proceeds to discuss the various theories of transmission of nerve impulse. With the progress of work along these lines, the question of transmission of nerve impulse and of the liberation of the chemical transmitter at synapses in the autonomic ganglia, and of the release of sympathin and acetylcholine at the neuromuscular and neuroglandular junctions, has attracted much attention in recent years. A purely electrical theory cannot explain all the data satisfactorily. The chemical theory like the electrical one has not received universal acceptance. Probably both the chemical and electrical factors are concerned with the transmission in the synapses and neuromuscular and neuroglandular junctions and further work will bring the two views into harmony.

Dealing with the autonomic nervous system, its centres in the brain stem and somatic response and the cortical control, Prof. De says that the evidence of control exercised by the cerebral cortex over the autonomic activities is fairly full and conclusive; nevertheless, some workers have doubted the accuracy of these conclusions. The weight of evidence, however, from the numerous experimental investigations and from clinical observations of various workers points to a localisation in the precentral cortex, more particularly in the areas 4 and 6 (Brodmann). Recently, much attention has been paid to the hypothalamic region of the brain and evidence has accumulated to show that it plays an important part in some of the vital reactions of the body. It is now generally agreed that in the hypothalamus and in the other parts of the upper brain stem, there exists a number of nuclei—supra-optic, paraventricular, infundibular and mamillary—which govern to a great extent the reactions of the autonomic nervous system. Karplus and Kreidl (1927) were the first workers to show that electrical stimulation of the hypothalamus produced excitation of the sympathetic nervous system. Evidence of the presence of the parasympathetic centre in the hypothalamus was given by Cushing (1932). Heslop (1938) also established that the anterior part of the hypothalamus is a parasympathetic and the posterior part a sympathetic centre. The importance of the hypothalamus in the regulation of body temperature is now unquestioned. From the experimental evidence, it is concluded that there are two distinct centres for the regulation of heat and cold. The centre for reactions to heat is situated in the anterior part of the hypothalamus. Lesions located in the medial part of the hypothalamus in the region of the infundibulum have no effect on either centre. On the clinical side evidence is accumulating that tumours in the neighbourhood of hypothalamus produce changes in the body temperature. Since the mechanism of heat production is activated by the posterior hypothalamus, it stands to reason that it is governed by the adrenergically (sympathetic) innervated structure coupled with the somatically controlled shivering reflex; on the other hand, the mechanism of heat loss is primarily governed by a cholinergic mechanism (parasympathetic). The function of maintaining body temperature is thus a highly integrated reaction involving both divisions of the autonomic system and also the important somatic reaction.

Finally, the author deals with the part the hypothalamus plays on the control of blood-sugar. Borbeck (1940) showed that in cats, lesions in the hypothalamus predisposed to insulin shock and to serve hypoglycæmia. From this and various other facts it is reasonable to infer that the spinal sympathetic nuclei may be capable of maintaining the blood-sugar level to some extent when their connections with the higher centre is severed. De investigated the role of general anæsthetics on the blood-sugar level on the spinal sympathetic nuclei when these nuclei are separated from higher centres. He could not find any signifi-

* Summary of Presidential Address delivered by Dr. P. De, before the Section of Physiology, Indian Science Congress, Bangalore, 1946.

cant part being played by these nuclei in the production of hypoglycæmia. The numerous facts and observations of Bard (1928) and Foulton (1929) and Ingrahm (1929) led De to believe that all the general anæsthetics release the sympathetic hypothalamic centre from the cortical control. The poorer the cortical depression, the less the hypoglycæmia, and with the deepening of anæsthesia, as more and more of the cortical control was withdrawn, the greater and greater was the rise of blood-sugar.

From the foregoing statements, it is clear that the hypothalamus plays a very important part in the body and controls a large number of body reactions. The results of observations on this subject, especially their association with the automatic nervous system, though quite extensive, are still very incomplete and await further work.

N. N. De.

THE INSIDIOUS TYPE OF LEAD POISONING*

In his Presidential Address, Dr. Bagchi has presented some of the important features of his investigations on lead poisoning and its bearing on the post-war industrial reconstruction. By the term lead poisoning or plumbism is meant that one has imbibed lead in quantities larger than what is normally ingested with food and drink or inhaled with air or otherwise absorbed, and has been adversely affected or intoxicated by it. Lead poisoning, like all other kinds of poisoning, may be acute or chronic. Dr. Bagchi has discussed only the chronic form of lead poisoning, which is mostly of occupational or industrial origin and to a less extent accidental. He then goes on to describe the toxicity of lead and lead compounds. Lead, in whatever form it is introduced in the system, acts as a poison. Even metallic lead is a potent poison—the toxicity depending on the extent of its surface exposed to the tissues. The route by which lead is introduced into the system is also a determining factor in the causation of the toxic symptoms. It has been proved that lead is absorbed in larger quantity and much more quickly through the lungs than through the alimentary tract or the skin and that lead introduced into the system by inhalation is about 100 times more toxic than when it is swallowed. Discussing the insidious type of lead poisoning—its pathology and symptomatology—the speaker says that the classical type of lead poisoning or plumbism in which all the characteristic signs and symptoms described in the text-books develop, offers no difficulty in diagnosis. But quite a large number of people who happen to absorb only very small amounts of lead over a long time either from drinking water, cooking utensils, vermillion or similar other sources do not develop any of these symptoms and yet are known to suffer from plumbism. These cases have lately attracted the attention of the workers in this line and have been proved by chemical and therapeutic tests to belong to the insidious types of lead poisoning, which had hitherto escaped the notice of the clinicians.

There are many difficulties that stand in the way of diagnosing cases of lead poisoning. In the diagnosis of plumbism, the history of exposure to lead is a very important factor. This guides the physicians in the right direction and the laboratory findings confirm his suspicion, while clinical features help him to clinch to his diagnosis. The laboratory tests include examination of urine and fæces by modern methods of chemical analysis and chemical examination of tissues, *e.g.*, liver, kidney, heart, lungs, intestine, spleen, cartilage, skin, brain and bone. Hair has been found to be a suitable material for the detection of abnormal lead absorption in the system. The chemical examination of blood does not help in any way in cases of insidious type of poisoning; in chronic cases, even with well-developed symptoms, the blood lead does not usually exceed the normal limits. Amongst other signs and symptoms may be mentioned blue line in the gums, and punctate basophilia, but unfortunately, both these are most unreliable and even when present they do not indicate lead intoxication but only lead absorption. Wrist drop, arteriosclerosis, and vascular spasms may be found only among those who absorb lead in heavy doses; rarely these are to be expected in insidious types.

Before concluding Dr. Bagchi laid stress on the importance of lead poisoning, particularly of the insidious type and its implication. As it is mostly of industrial origin and as rapid industrialisation is expected early, he puts it forward as a plea for reorientation of the system of Public Health Administration and Medical Education in this country. Dr. Bagchi impressed on the importance and development of Industrial Hygiene and felt that the establishment of a Central Research Institute for Industrial Hygiene, creation of an Industrial Health Research Board and raising the standard of teaching in Medical and Public Health Sciences will be helpful in bringing about the solution of new problems of health and disease arising from the industrialisation of the country and thus to protect and improve the health of the workers.

N. N. De.

* Abstract of Presidential Address to the Section of Medical and Veterinary Science, delivered by Rai Bahadur K. N. Bagchi, before the 33rd Session of the Indian Science Congress, Bangalore, 1946.

DEVELOPMENT OF KIDNEY IN FISHES*

While the kidney in all vertebrates is, more or less, derived from the same embryological source, the precise mode of its development varies in different classes of vertebrates. The first developed part of the kidney which is functional in the larval life of frogs, bony fishes and some other fishes is very rudimentary amongst sharks. The larval kidney serves the larva for some time. But as development proceeds, the succeeding portions of kidney develop and this development takes place in two stages. The first stage represents the whole kidney in all fishes except sharks where the hinder elements alone function in the adult and in this respect the sharks resemble the

* Abstract of Dr. Moghe's Presidential Address to the Section of Zoology and Entomology, Indian Science Congress, Bangalore, 1946.

higher vertebrates. Dr. Moghe dealt with the development of kidney in all groups of fishes such as the sharks and fishes, ganoids and bony fishes. In the last group his own investigations point to a different mode of development from the commonly accepted one found in the text-books. The accounts in text-books are based on the investigations of Felix published in 1896 and 1902 and these place the bony fishes in a separate class from other fishes and vertebrates. Dr. Moghe, however, considers that the development of kidney in the bony fishes is of the same order as in other vertebrates. Another controversy emphasised by Dr. Moghe relates to the larval kidney of most fishes. Is the kidney duct formed first or the kidney tubule? In the opinion of some workers the duct is formed first and the anterior end of the duct differentiates to form the kidney tubule; others consider that the kidney tubule is formed first and its terminal end opens into the duct which is independently formed.

B. S. B.

OBITUARY

THE LATE MR. KAPILRAM H. VAKIL
M.Sc. (Tech.), F.R.I.C., A.M.I.Chem.E.

On the 28th of January 1946, the death occurred at Mithapur, of Mr. Kapilram H. Vakil, and with his passing away from our midst, scientific and industrial India lost one of her most eminent sons. Mr. Vakil was a self-made man. After graduating from the Elphinstone College, Bombay, he proceeded to England for further studies in technological subjects and very soon obtained the M.Sc. (Tech.) degree of the Manchester University as also several other diplomæ in applied chemistry. Mr. Vakil was very early recognised as an expert in oil and soap technology and was immediately absorbed by the Tatas. His passion and desire to expand his knowledge to the benefit of the country soon found Mr. Vakil conducting work on problems relating to salt and alkali industries. He was mainly instrumental in setting up the huge alkali factory in Dharangadhara State as also the Tata Chemicals plant at Mithapur, the latter being the largest unit in India producing marine chemicals. To keep himself abreast of the terrific strides made in America and Europe, he visited these continents over a dozen times and personally visited important works to get himself acquainted with the latest developments in processes as also in machine design.

On numerous occasions, Mr. Kapilram Vakil was approached both by Government and non-official bodies to preside at or to be a member of several committees. Important among these may be mentioned the Subjects Committee of the Indian National Congress, the Indian Merchants' Chamber, the Technical Education Committee (Government of Bombay), the Heavy Chemicals Committee (C.S.I.R.), the Electro-Chemicals Committee (C.S.I.R.), the Heavy Chemicals Panel (P. & D. Department of the Government of India), the Bombay Provincial Industries Chemical Sub-Committee and the Provincial Industrial Research Committee. Mr. Vakil was a member of the Advisory Board which was set up to guide the recent Fertiliser Mission. He was also a member of the Advisory Board of the Royal Institute of Science, Bombay, and the Council of the Indian Institute of Science, Bangalore. Mr. Vakil's diverse interests will become evident when it is mentioned that he took an important part in the framing of the Santa Cruz (East) Town Planning Scheme.

As the author of several important papers and books on technical subjects, Mr. Vakil's name was a by-word with scientists and industrialists alike. Several of his industrial processes are patented and are in use even now in India as well as abroad.

His devotion to science was to the very extreme and he dedicated all his time, nay his very life, to the cause of the scientific and industrial development of his country. It will be very difficult to fill the void created by his sad demise. May his soul rest in peace and may we be given the sense of duty to keep on burning the torch of enlightenment which he has lit!

MATA PRASAD.

PROF. JOHAN IVAR LIRO

HOSTILITIES having been ended, news have begun to trickle down from Europe about the happenings during the past six years. Sad news has reached us that Prof. Johan Ivar Liro has been lost to Mycological Science by his sudden death on September 16, 1943, at the age of 71.[1] Known to most of the earlier mycologists by his former name, Lindroth, Prof. Liro was the Professor of Plant Biology and Plant Pathology at the University of Helsinki, Finland. He occupied many important posts including the Directorship of the University of Turku in 1922.

Few persons were endowed with such keen intellect and insight in the study of smuts as late Prof. Liro. In addition to his numerous papers on the smuts of the world, his two comprehensive works, *Die Ustilagineen Finnlands*, Parts I & II, would remain for many years to come, the most authoritative treatise ever written on the subject. His clear and analytical way of judging scientific matters often made him appear to err against the world though right to himself. His treatment of the genus *Urocystis* as a synonym of *Tuburcinia* aroused quite a sensation among the mycologists. While most of the workers in the European continent accepted the views put forward by Prof. Liro about the genus *Tuburcinia*, he was sharply criticised by the American and English schools who preferred to bring Article 4 of the International Rules of Botanical Nomenclature into force and thus conserve the name *Urocystis*. He made valuable contributions to the study of rusts of Finland. In addition to these, he was deeply interested in entomology having made detailed studies in the gall mite genus *Acarina*. Two genera were named in his honour, *Liroa*, a genus of smuts, by Prof. R. Ciferri, and *Lindrothia* (= Puccinia), a rust genus, by Dr. H. Sydow.

M. J. THIRUMALACHAR.

1. E. Kitunen in *Ylipainos Maataloustieteellinen Aikakauskirja*, 1943, 15.

LETTERS TO THE EDITOR

VARIATION OF THE APPARENT SHAPE OF THE SKY WITH INTENSITY OF ILLUMINATION

MILLER AND NEUBERGER[1] have recently reported some measurements of the apparent shape of the sky under different meteorological conditions. Their observations are entirely confined to the day-time sky. The only available data relating to the shape of the night sky are from measurements made by Reimann[2] on different moon-lit and moonless night skies. Little effort has, however, been made so far to examine how the apparent shape of the sky varies with the intensity of illumination in the sky. In order to investigate this, it is essential that continuous observations should be made as the sun sets or rises, under clear weather conditions. The results obtained by the author under such conditions at Madras are described in this article.

It is satisfactory, for all analytical purposes, to assume a circular profile for the meridional section of the sky. The angular elevation of the mid-point of the arc joining the horizon to the zenith, called the half-arc angle, is fairly sensitive to the variation of the sky shape. An accurately-calibrated angle-meter has been used to measure the angle. It is easily seen that if the sky is observed from a point O and the distances from O to the horizon and the zenith are respectively OH and OZ, the half-arc angle will then be larger, the higher the zenith or the less distant the apparent horizon.

The results of the measurements on two different days of clear sky at the time of sunset are given in Table I. Each of the values given in this table is the mean of 16 measurements made in four different directions and thus represents the mean sky shape at the time. The quantity ρ in this table is the ratio OH/OZ calculated from the average values of the half-arc angle.

TABLE I

Time of observation→	Minutes before sunset			At sunset	Minutes after sunset			
	30	20	10		10	20	30	50
28-12-'45 ..	..	27·5°	..	26·3°	25·0°	24·9°	25·0	24·7
18-1-'46 ..	27·4°	26·8°	26·3°	25·9°	24·8°	24·5	24·7	24·7°
ρ .	2·67	2·73	2·54	2·87	3·02	3·08	3·06	3·08

The author's values for the half-arc angle for the day-time, moonless and full-moon skies are given in Table II. These are the arithmetical means of a number of observations made on different days of clear weather. The values arrived at by Reimann are also included in this table for comparison.

TABLE II

Kind of Sky→	Day Sky	Full-moon Sky	Moonless Sky
Author ..	27·5°	25·2°	24·2°
Reimann ..	22·4°	26·6°	30·0°

It is seen from Table I that the half-arc angle, which has a value of 27·5° during day-time in clear weather, begins to decrease from about half an hour before sunset and continues to decrease thereafter (except for a slight rise between 20 and 30 minutes after sunset) until it attains a minimum value about an hour after sunset. The minimum value reached will lie between 24·2° and 25·2°, depending on the amount of moon-light illuminating the sky. The increase in the ratio OH/OZ shows that, with decreasing intensity of illumination, the horizon seems to drift farther and the zenith to come lower. The tendency observed on both the days for the half-arc angle to rise slightly between 20 and 30 minutes after sunset may probably be ascribed to the after glow following sunset. The observations of Reimann in Table II, which would indicate that the half-arc angle should increase with decreasing intensity of illumination, are not supported by the author's results.

It may be noted with interest from the above tables that the intensity of illumination in the sky about 8 minutes after sunset has the same influence on the apparent shape of the sky as the full-moon well above the horizon.

Further work is in progress.

The author wishes to thank Mr. B. N. Sreenivasaiah, Meteorologist, St. Thomas Mount, Madras, for his kind interest and encouragement during the progress of this investigation.

Meteorological Office,
St. Thomas Mount P.O.,
Madras, D. VENKATESWARA RAO.
January 30, 1946.

1. Miller, A., and Neuberger, H., *Bulletin Amer. Met. Soc.*, 1945, **26**, 212–16. 2. Pernter, J., and Exner, F., *Meteorologische Optik*, 1922, 2nd Edn, 5–56.

MAGMATIC WATER IN THE DECCAN TRAP (PLATEAU BASALTS), NEAR NAGPUR, CENTRAL PROVINCES

THE authors, while investigating the Deccan traps of the neighbourhood of Nagpur, visited the Boregaon quarry, about two furlongs in length and with a big face. It is situated a little north of the Nagpur-Kamleshwar Road past the milepost 3 marked on map-sheet 55 O|4. On it, however, it is wrongly marked as manganese quarry. It is really a road metal and building stone quarry in the Deccan trap. While breaking a specimen of the Deccan trap from the rock, the authors observed a very unusual and interesting phenomenon. As soon as the piece was detached, a small amount of water, which was enough to wet part of the rock splashed from inside. It was carefully examined whether it could be meteoric water and whether any rain or surface water could have percolated or soaked into the rock by any means. The rock is igneous and impervious to water and no percolation or soaking was possible. The extensive quarry was perfectly dry and not a drop of water was seen issuing from even well-marked joints. The original location of this rock was right into the interior and was exposed after considerable vertical and lateral blasting. On further examination it was found that this water issued from a vesicle right inside the rock which was almost at the base of the quarry. It was an astonishing experience and the authors started investigating the occurrence of such water. Evidently, the steam, *i.e.*, water above critical temperature, inside the vesicle being right into the interior of the flow, could not escape and had congealed into water on the lowering of temperature or the cooling of the rock. It may be noted that Dr. (now Sir) L. L. Fermor has recorded a similar occurrence of water while breaking a block of Bhusawal cores in an attempt to collect chlorophæite.[1] As this happens to be the second observation of this peculiar and rare occurrence of water in the Deccan trap it has been deemed advisable to place it on record.

Unfortunately, the volume of water being small and the authors being unaware of its concealed existence, it was splashed. The association of steam with volcanic phenomena is familiar but its actual condensation into water and its having remained trapped in a vesicle since the close of the Mesozoic era for about forty million years is a phenomenon not commonly recorded in geological literature.

From the study of rocks and other experiments, the hydrous character of the natural magma has been concluded but here is definite evidence about its free occurrence in the rock itself which should put any doubt whatsoever, at rest. Thus the magma of the Deccan trap (plateau basalts), which is believed to be the primary basaltic magma, was definitely hydrous. Under the microscope some rock-forming minerals like quartz, topaz, etc., reveal the occurrence of water, particularly under high power, but the evidence in question presents an indubitable and definite megascopic evidence.

The occurrence of water in the magma is known to lower the viscosity or increase the fluidity of the magma. It is actually known that some of the flows of this lava have travelled sixty miles or even more. Then as contrasted to pyrogenetic minerals, there is the formation of hydatogenetic minerals, *i.e.*, those which crystallise in the presence of water. There occur a host of the latter minerals in the Deccan trap.

The mineral and chemical composition of the Deccan trap, which has yielded this free water,

is described briefly below. The rock is almost black or greyish-black in colour. It may be compact but vesicular and amygdaloidal varieties are common. A vesicle may attain the maximum size of one to two cm. in diameter. The various flows reveal a variation in texture. Under the microscope the rock resolves itself into a palagonite-bearing dolerite with a sub-ophitic texture. It is composed of labradorite, augite, magnetite with interscrtal primary glass. Palagonite has both brownish and greenish colour. The primary glass is usually of pink colour but it also occurs in irregular patches of green colour. Microlites and small crystals of felspar, magnetite and augite occur as inclusions in primary glass. There is evidence to show that augite, felspar and magnatite along with glass have crystallised simultaneously. Chlorophæite is also present in small amounts showing clear fibrous structure. In a few cases augite is seen altering to brown palagonite in successive stages. In some rocks orthoclase occurs in very small amounts and primary glass may be almost absent. A little apatite is also present as an accessary.

Both the amygdaloidal and compact varieties of the Deccan trap from this locality were analysed by Mr. B. N. Chaturvedi.

	I	II
SiO_2	48·08	46·85
Al_2O_3	13·85	13·28
Fe_2O_3	5·50	7·52
FeO	10·20	6·70
MgO	4·00	6·55
CaO	10·70	11·96
Na_2O	2·71	2·85
K_2O	1·08	1·21
H_2O^+	1·10	1·02
H_2O^-	0·56	0·42
TiO_2	2·80	2·60
	100·58	100·96

(1) Amygdaloidal dolerite from Boregaon quarry, near Nagpur.
(2) Compact dolerite from Boregaon quarry, near Nagpur.

These analyses contain 1·10 and 1·02 per cent. of combined water apart from the free water mentioned above. The average percentage of combined water of 11 analyses of these basalts by H. S. Washington is 1·70, while the maximum represents 3·2 in a basalt from the Kurli Hill, Baroda State.

H. L. Chhibber.
B. N. Chaturvedi.

Benares Hindu University,
November 10, 1945.

1. *Rec. G. S. I.*, 1926, **58**, 128.

DECOLORISATION OF NICOTINIC ACID EXTRACTS

Acid hydrolysates from plant products and animal tissues being deeply coloured have to be decolorised before treating with the cyanogen bromide-aniline hydrochloride reagent for the colorimetric estimation of niacin. Most of the suggestions for decolorising these extracts are unsatisfactory. With charcoal, fuller's earth, permutit, etc., a fairly high percentage of niacin is found to be adsorbed, while with Pb-acetate and $Hg(NO_3)_2$, there was interference of the anions with colour development.[1,2]

According to the recent method of Friedemann and Barborka,[3] the decolorisation is brought about by $Zn(OH)_2$ precipitated within the solution by NaOH. Significant features of this method are that (*i*) pH of the solution is adjusted to 6-7—a condition pre-requisite to the treatment with the reagent, (*ii*) ionic interference is not likely since the $Zn(OH)_2$ is very little soluble at pH 6-7 and (*iii*) zinc hydroxide does not adsorb nicotinic acid.

Using this method, we succeeded in decolorising to a great extent the acid hydrolysates from cereals. However, on subsequent treatment with the reagent we found that the solutions developed a reddish tinge which interfered with the colour matching. The intensity of the colour varied with different cereals; *e.g.*, with wheat (*Triticum vulgare*) it was cobalt red and with ragi (*Eleusine coracana*) it was slightly reddish.

Attempts were then made to selectively remove this red colour with solvents like chloroform, ether and petrol-ether without affecting the yellow colour due to niacin. Ether and petrol-ether removed completely the red colour leaving the aqueous layer characteristically yellow (due to niacin). Chloroform was found to remove, in addition, a fair proportion of the niacin colour. Ether was found to be more suitable inasmuch as the aqueous layer shaken with it showed no tendency to emulsify as was the case with petrol-ether.

To determine if ether had any effect on the yellow compound of niacin, test solutions containing a known amount of niacin were, after the addition of cyanogen bromide and aniline hydrochloride, shaken with an equal volume of ether for two to three minutes. The colours were then compared on Pfaltz-Bauer fluorophotometer, with those of the corresponding controls without treatment with ether. The results are shown below:—

Niacin in μg

Test solution No.	Treated with ether	Untreated with ether
1	4·00	4·00
2	3·50	3·00
3	4·50	4·50
4	4·75	4·50
5	4·00	4·50
Mean	4·15	4·10

Ether does not remove the characteristic yellow colour due to niacin.

R. G. Chitre.
D. B. Desai.

I.R.F.A. Nutrition Research Unit,
Seth G. S. Medical College,
Parel, Bombay (12),
January 8, 1946.

1. Giri, K. V., and Naganna, B., *Ind. Jour. Med. Res.*, 1941, **29**, 585. 2 Bandier, E., and Hald, J., *Biochem. J.*, 1939, **33**, 264. 3. Friedemann, T. E. and Barborka, C. L., *J. Biol Chim.*, 1941, **138**, 785

CHEMICAL COMPOSITION AND PHYSICAL CHARACTERISTICS OF SOME NATURAL FATS AND OILS

The recent contribution by Achaya and Banerjee[1] makes it desirable that we should announce the line of work on which we have been engaged for some time and to summarise the theoretical basis of our work. Natural glycerides, as products of a series of complex metabolic processes, need not be expected to conform to the exact demands of any numerical formula. Nevertheless, a critical study of published data reveals regularities too pronounced to be accidental.

Two physical determinations usually carried out on fats and oils are the melting points and titre values. A little reflection would show that both these are functions of the acid content—the higher the saturated acid content the higher the two values. As far as we are aware no one seems to have tried to work out any relation between these values and the actual and potential trisaturated glyceride content (the potential value being calculated from the saturated acid content). Let us take the case of coconut oil. The m.p. and titre as given in literature[2] are 23 to 26 and 20 to 23 respectively (variation due to different samples). The molecular percentages of saturated acids[3] are, for two samples, 93·9 and 92·9 respectively. The cube of these concentrations expressed in percentages are 82·8 and 80·3 as against the experimental values (for fully saturated glycerides) 86 and 84 respectively. The difference between the experimental values and the "cube-value" is, approximately, 3. In this case the experimental value is higher than the cube-value, and fats and oils showing this characteristic we propose to call "Positive Fats". Fats of the palmæ and internal depot as well as milk fats of the higher animals belong to this class. Under "Negative Fats" are included vegetable glycerides which do not contain any appreciable amounts of acids lower than myristic, external fats of higher land animals as well as fats of the lower animals. Borneo tallow is an example of a negative fat. Its m.p. and titre values are 31 and 51 respectively. The molecular percentage of saturated acids are 62·9 and 62·8 (the cube-value being 24·9 and 24·8) as against the molecular percentage content experimental of trisaturated glyceride: 5·1 and 4·5. The difference in both values is 20 and the titre value being higher than the m.p.

The negative fats have a peculiarity of their own. The observed constancy of difference noted is a function of the unsaturated acid content also. Available data reveals that the constancy of difference is maintained till the molecular concentration of the unsaturated acids reaches 48 per cent. From 48 to 62 the difference between the experimental values for fully saturated triglyceride and the cube-value is half the difference between the titre and m.p. From 62 to 68 the value becomes a quarter and from 68 to 71 it is one-eighth. The last case requires further scrutiny before being accepted with confidence. Another interesting fact about negative fats is also worth recording and may be illustrated by an example:—

Let the unsaturated and saturated acid content be 48 per cent. and 52 per cent. Then the cube-value (saturated acid) is 14, a figure identical with the value by which the negative fats falling under the second category (48 to 62) differ. The corresponding figures for the second and third cases are 5·5 and 3·5 respectively.

What the exact interpretation of the above we are not in a position to say but we hope that the work engaging our attention would help in this direction.

A. R. Sukumaran Kartha.
K. N. Menon.

Maharaja's College,
Ernakulam,
January 30, 1946.

1. Achaya and Banerjee, *Curr. Sci.*, 1946, **15**, **23**. 2. Lewkowitsch, Vol **2**. 3. Hilditch, *The Chemical Constitution of Natural Fats.*

TAMARIND SEED "PECTIN"

Our earlier observation,[1] that the alcohol precipitate from an aqueous extract of tamarind seed kernel[2] differs fundamentally from fruit pectins, in spite of its forming a well-set jelly in presence of appropriate amounts of sugar and acid, has since been confirmed by other workers.[3,4] The evidence in regard to the identity of the sugars obtained is, however, conflicting. This communication records the results of our further studies on the chemical nature of this polysaccharide fraction.

A comparative study of different methods of purification of the alcohol precipitate[2] showed that the most convenient method for the removal of proteins was the one already described.[1] The alternative method of Ghose and Krishna[4] was not quite satisfactory as, by this procedure, extraction was incomplete and the proteins were only partially removed while, regeneration of the substance after precipitation as copper salt yielded a discoloured product.

The purified tamarind seed preparation,[1] unlike fruit pectins, does not reduce Fehling's solution except when hydrolysed with acids. Using different concentrations of acid and varying periods of hydrolysis, it was observed that the maximum liberation of reducing sugars resulted on hydrolysis with 3 per cent. sulphuric acid for 8 hours. Expressed as glucose, this amounted to 41·5 per cent. of the weight

of the substance, suggesting considerable destruction of sugars during hydrolysis[5] although a value as high as 83 per cent. has been reported under similar conditions;[3] that destruction of sugars could happen was, however, shown conclusively using mixtures of known amounts of different hexoses and pentoses. Taka-diastase, 0·1 per cent., while without action on fruit pectins, hydrolyses the product from tamarind seed meal giving 30 per cent. reducing sugars after 48 hours incubation at room temperature. The only sugars that could be identified in these hydrolysates were xylose, galactose and glucose. From the yields of furfural on distillation with 12 per cent. hydrochloric acid[6] and of mucic and saccharic acids on oxidation with nitric acid of specific gravity 1·15,[7] the percentages of these sugars were calculated as 28·42, 16·19 and 55·36 respectively, corresponding, approximately, to a molecular proportion of 2 : 1 : 3. It cannot be stated at present whether the gluco-galacto-xylan has a ring[8] or a chain structure.[9] No methyl ester groups could be estimated using any of the improved methods[10] while the uronic acid residues[11] amounted only to 3·44 per cent.

These observations on the nature of the products of oxidation and hydrolysis are in general agreement with those of Ghose and Krishna[4] and do not support the claims made by Damodaran and Rangachari,[12] particularly regarding the presence of arabinose among the products of hydrolysis. The discrepancy is explained by the latter authors as "unimportant"[12] and as due to the inhomogeneous nature of the preparation. While, as already reported, we have succeeded in obtaining a preparation of fairly constant composition to which the foregoing studies were confined, we feel that conditions of extraction and precipitation can only alter the proportion but not the nature of the existing constituents in the polysaccharide fraction.[13,14]

Other observations of interest are summarised here. The purified preparation of the tamarind seed meal is dextro-rotatory The acid number is low[1] but treatment with decinormal alkali for varying periods of time is followed by increased use of the latter as shown by back titration with standard acid; the acid value at the end of 48 hours increasing to over 500 milli-equivalents per cent. of carboxyl group (over 20 times the original). Similar behaviour is shown by fruit pectins as well as other gums and mucilages where this phenomenon could be explained as due to de-esterification and liberation of acids.[15] With tamarind seed preparation, however, the fact that the gel-forming constituent can be recovered even after boiling with excess of decinormal alkali,[1] precludes the possibility of any alteration or splitting of the polysaccharide. Further work is obviously needed to throw more light on this phenomenon.

The only property which tamarind seed preparation shares with fruit pectins would thus appear to be in its formation of sucrose-acid jellies. Even here, it has been observed that the jellies, under all conditions, are tougher in consistency than those obtained from fruit pectins. A study of sugar-acid jellies with tamarind seed preparation using an apparatus similar to the pectinometer of Luers and Lochmüller[16] showed that they had greater gel strengths than the corresponding jellies of fruit pectins and that gel strength was quite unrelated to associated proteins in impure preparations,[2] there being a steady increase following their removal.

Further details will be published elsewhere.

G. R. SAVUR.
A. SREENIVASAN.

Foods and Drugs Section,
Dept. of Chemical Technology,
University of Bombay,
Bombay 19,
February 5, 1946.

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CHEMOTHERAPY OF SOME ACRIDINE DERIVATIVES IN FOWL MALARIA

THE best method of combating malaria is to prevent infection by suitable anti-mosquito measures, but these can be carried out by relatively rich and well organised communities. While the cinchona alkaloids are still the most widely used antimalarial drugs, cinchonine is less effective than quinine against malaria,[1,2,3,4] by virtue of the former's undue toxicity to heart, lower partition coefficient, and inability to prevent the emigration of leucocytes. Following the elucidation of the general formula of the cinchona alkaloids,[5] the seat of the antimalarial activity in the quinine was attributed to the quinoline part of the molecule. This suggestion led to the synthesis of a number of substituted quinoline derivatives containing 8 or 4-alkylamino side-chains with or without a secondary alcohol,[6,7,8] of which plasmoquine proved to be powerful synthetic antimalarial. The success which was met with in the use of acridine derivatives as antiseptics[9,10] led to the search for antimalarials in the acridine ring system. In 1930 Mauss and Mietzch reported the synthesis of the dihydrochloride of 2-methoxy-6-chloro-9-(8-diethylamino-α-methyl butyl amino) acridine called atebrine. Atebrine is reputed to be less toxic than plasmoquine and compares favourably with quinine in destroy-

ing the parasites in the blood by acting on the trophozoites of all the three types of the parasites.[11,12,13] Though the synthesis of atebrin has stimulated the search for new synthetic antimalarials,[14,15,16,17,18] the drug treatment of malaria has been shown to be ineffective even under optimum conditions, owing to two fundamental disadvantages inherent in the drugs now in use. First, these drugs do not destroy all the parasites in the human host and thus prevent the possibility of a relapse and consequently a constantly increasing carrier-reservoir accumulates tending to the spread of malaria. Secondly, these drugs have no action on the sporozoite stage of the parasite and hence cannot prevent the development of clinical malaria following the bite of an infected mosquito.[19] Search for synthetic antimalarial drugs must take cognisance of these inherent defects.

In this communication, the results of our investigation of the antimalarial properties of products analogous to atebrin, obtained by introducing carbamido, semicarbazido, thiocarbamido, thiosemicarbazido and also their corresponding alkyl substituted derivatives in the usual atebrin nucleus, have been recorded. The alkyl substituent as in the case of atebrin was '*d*-diethyl-amino-α-methyl-butyl' group. A number of compounds were obtained and their efficacy in fowl malaria was tested; the results are given in Table I.

EXPERIMENTAL

English fowls, of an average weight of 350-400 gm., were inoculated with intramuscular injections of 0·5 c.c. of citrated blood from fowls infected with *P. gallinaceum*. One group was treated with the compounds to be tested and a second group with mepacrine hydrochloride, while a third batch was kept as control. In the freshly inoculated fowls the parasites usually appeared on the seventh day after inoculation and the infection was considered to be very heavy on the ninth day. Both mepacrine hydrochloride and the substance to be tested were given in doses of 1 mg. per 20 gm. body-weight,[20] intramuscularly on the day following the appearance of the parasites in the blood, when the infection was considered to be moderate. The injections were continued for three successive days, and the blood slides were examined every day and also for several days after the last injection. The antimalarial properties of the substances were judged by their effects on the rate of disappearance of the parasite from the blood and also by the morphological characteristics of the parasite. A curative result was recorded when parasites could not be detected on thin films after repeated examination for several days following the day of disappearance. The results are tabulated below (see table).

From an analysis of the table it can be seen that out of the six compounds tested, only two are active against *P. gallinaceum*—2-chloro-7-methoxy-5-carbamido and 2-chloro-7-methoxy-5-thiocarbamido acridine—and the results compare very favourably with mepacrine hydrochloride. One of the fowls treated with the compound (1) showed slight relapse after 12 days, but it was only transient and the parasites disappeared from the blood on the next day, and could not be detected for a period of one month. In the case of compound 2, two similar cases of relapse of a transient nature were noted. With the fowls treated with mepacrine one case of relapse was noted. All the untreated fowls kept as control died ten days after inoculation as a result of heavy infection.

TABLE I

Name of the compounds	Activity against fowl malaria
1. 2-chloro-7-methoxy-5-carbamido acridine	+
2. 2-chloro-7-methoxy-5-thiocarbamido acridine	+
3. 2-chloro-7-methoxy-5-semicarbazido acridine	—
4. 2-chloro-7-methoxy-5-thiosemicarbazido acridine	—
5. 2-chloro-7-methoxy-5-(δ-diethyl-amino-α-methyl) -butyl semicarbazido acridine	—
6. 2-chloro-7-methoxy-5-(δ-diethyl-amino-α-methyl)-butyl thiosemicarbazido acridine	—

It is interesting to note that introducing carbamido and thiocarbamido substituent in the usual atebrin nucleus does retain the antimalarial property of the resultant compounds, so far as fowl malaria is concerned.

Further study in detail is in progress.

Our thanks are due to Dr. K. P. Menon for his kind interest and help during this investigation, to the authorities of the King Institute of Preventive Medicine, Guindy, for supplying strains of *P. galliniceum*, and to Prof. P. C. Guha and Mr. S. P. Mukerjee of the Organic Chemistry Laboratory, Indian Institute of Science, Bangalore, for supplying the various compounds studied.

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S. NATARAJAN.
N. N. DE.

Pharmacological Unit,
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Bangalore,
January 22, 1946.

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EFFECT OF QUALITY OF STARCH ON DRY-CELL PERFORMANCE

STARCH, agar-agar and dextrin are used in dry-cell manufacture to render the electrolyte unspillable; starch is the most widely used. Experiments carried out in a dry cell manufacturing concern at Bombay making use of locally available starch, revealed that the cell performance was not up to the standard specifications. Therefore, attempts were made to find whether any improvement in the quality of starch would show betterment in the performance of dry-cells produced.

The starch obtained from the market was found to contain about 16 per cent. non-starchy matter. After purification the starch (containing 0·5 per cent. impurities) was employed in making dry-cells.

Starch sample	Initial voltage	Amps.	Continuous burning hours (till voltage drops to 0·6)
1. Unpurified	1·55	5·2	6 hrs. 30 mts.
2. Purified	1·55	6·5	9 hrs. 45 mts

Improvement in the cell performance is (see Table) brought about by using purified starch which probably possesses better gelatinising properties. This is in conformity with a previous observation[1] that starch is better than flour for the manufacture of dry-cells.

Department of Technology,
Andhra University,
Guntur, D. VENKATESWARLU.
February 11, 1946.

1. Joglekar, Subba Ramiah and Verman, *Indian Industrial Research Bulletin*, No. 23, p. 17.

COMPLEX COMPOUNDS OF MERCURIC CHLORIDE

MR. A. K. DEY has published a note in *Current Science* (January 1946, p. 24) on "Chloromercuric acids", wherein it is stated that he has obtained evidence from conductivity data for the existence of (1) $HHgCl_3$, (2) H_2HgCl_4 and (3) H_4 $HgCl_6$ and also for the corresponding potassium salts.

It happens that a parallel investigation is being carried out here on the complex compounds of $HgCl_2$, where conductivity is one of the properties studied and the preliminary results were communicated to the Indian Science Congress (paper 12, p. 118, *Abstracts*, 1945; and paper 66, p. 18. *Abstracts*, 1946). I have reported the existence of three compounds of the formulæ.

(*a*) $2KCl.HgCl_2$, (*b*) $KCl.HgCl_2$, (*c*) $KCl.2HgCl_2$. The possibility of other complex compounds is under investigation. Compounds (*a*) and (*b*) correspond to (2) and (1) of Dey. In my case the evidence for the existence of the compound $KCl.2HgCl_2$ is unmistakable.

Further, according to Mr. Dey, "the mixture was more conducting than either constituent and the conductivity values were even greater than the sum of the conductivities of the constituents". My observation is just the reverse. Starting with a solution of KCl of fixed concentration increasing quantities of $HgCl_2$ were added. It was found that the original conductivity of KCl *decreased* and the plot was not regular, but gave kinks with abnormal decrease of conductivity at concentrations corresponding to the compounds listed.

Another observation was that the cell constant of the conductivity cell (with platinum electrodes) always decreased appreciably when the cell had been in use for some time with solutions containing $HgCl_2$.

Details will be published later.

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February 5, 1946.

FURTHER NOTE ON AN IMPROVED METHOD OF LOCATING TANNINS IN PLANT SECTIONS

SINCE the publication of the note entitled "An improved method of locating tannins in plant sections" in *Current Science*,[1] further work has successfully removed certain shortcomings, inherent in the former method. This has been made possible by the use of the new preparation of one of the reagents, *i.e.*, solution A according to Snell and Snell.[2] The original preparation involves large quantities of chemicals which are wasted because the preparation deteriorates on storage and a few drops of the reagent are only needed for staining a dozen or more sections at a time. Snell's method has, therefore, been modified and is described below.

PREPARATION OF THE REAGENT

Solution A.—2.25 gms. of phosphotungstic acid, 0·5 gm. of phosphomolybdic acid and 2 c.c. of syrupy phosphoric acid are taken in a 200 c.c. conical flask to which are then added 20 c.c. of distilled water. The mixture is then boiled over a water-bath under reflux for two hours, allowed to cool. 4 gms. of lithium sulphate solution, one drop of bromine and 2 c.c. of concentrated hydrochloric acid are added to the mixture which is then boiled for 20 minutes without any condenser and allowed to cool. The mixture is then diluted to 50 c.c. instead of 25 c.c. as in the previous preparation.[1] The mixture can as well be diluted to 100 c.c. and this solution is also good enough for staining plant sections in the majority of the cases but in the case of plant materials extremely low in tannin content, the staining is not so prominent in contrast as with the stronger solutions.

Lithium carbonate can alternatively be used in place of the sulphate in which case more of the concentrated hydrochloric acid has to be added in order to decompose all the solid carbonate. All other operations are just the same as above.

The preparations are yellow in colour and free from any green tinge which is indicative of the presence of reduction products. The reagent must be preserved in amber coloured bottles, wrapped in black paper and well protected against dust as organic materials tend to reduce the strength rapidly.

PROCEDURE

Procedure is the same as in (1). After passing the stained sections through the various grades of alcohol they are cleared either in xylol or clove oil and then mounted in balsam if permanent sections are necessary.

It has been observed that in the winter season the use of a still lower grade of alcohol as 20 per cent. may be found necessary in order to effect a better clarification of the plant sections.

This method can most profitably be utilised in quickly identifying the presence or absence of tannins in the various plants or plant parts by staining their sections with solution A and neutralising with solution B and immediately examining them under a microscope without trying to prepare any permanent slides at all. The portions of the plant sections containing more or less tannin accumulations are stained deep or light steel blue which can be seen at a glance under a microscope

ADVANTAGES OF THE NEW PREPARATION

The few advantages of this new preparation are as follows:—

Firstly, the preparation of the reagent (*i e.*, solution A) is highly economical as it entails the barest minimum quantities of the chemicals for the purpose; secondly, in order to get equally good effects, half the volume of the reagent is only necessary than the former preparation; thirdly, no cloudy-white precipitate is formed even if an excess of the reagent is by chance added and fourthly, there is no immediate hurry, as in the former method, in passing the stained plant sections through the various grades of alcohol for washing them.

A list of the new plant materials wherein the presence of tannins has been demonstrated by this preparation, is given below:--

TWIGS.—*Ægle marmelos, Artocarpus integrifolia, Citrus decumana, Crotalaria* sp. (Atoshi), *Duranta Plumieri, F. bengalensis, F. religiosa, Eugenia jambolana, Glycosmis pentaphylla, H. sabdariffa* var. *altissima* (red and white), *Nephelium Litchii, Psidium Guava, Spondias Mangifera, Zizyphus jujuba.*

Jute Agricultural Research
Laboratories, Dacca, A. C. BOSE.
Indian Central Jute Committee,
July 27, 1945.

1. Bose, A. C., *Current Science*, 1943, **12**, 327.
2. Snell, F. D., and Snell, C. T , *Colorimetric Methods of Analysis*, **2.** Second printing, New York, p. 351.

HAIR BALL IN THE STOMACH OF A CALF

'PICA' or perversion of appetite is known in various animals including man. Habit of eating materials, which are not normally included in the diet of the species sometimes arises out of physiological needs. Cattle, fed with diet poor in calcium, may take to bone eating. Wool eating in sheep and hair licking in calves may be due to parasitic infection of skin or may be due to parasitic infection of skin or may be a simple perversion of habit. This habit frequently gives rise to hair balls in the stomach resulting in disturbances of digestion with ultimate minor or grave consequences. Death due to obstruction of alimentary canal is not rare.

In this laboratory, recently, a hair ball was found in the stomach of a male calf of four months age. It was a globular clastic solid mass closely resembling an ordinary tennis ball in shape, colour and external appearance. Only the size was just a bit larger. On breaking in two equal halves the ball was found to consist almost solely of large number of dark black hairs interwoven very closely with practically no cementing material. Beneath the outermost thin layer of muddy white colour, another concentric layer of dark black hairs was clearly distinguishable; this second layer was about half centimetre in thickness. Inside this layer the arrangement was that of a closely packed irregular lump. The individual hairs were long. The uniform colour, thickness, shape and size of the hairs suggested that they were devoured from the same source. The calf itself was completely white. So the hairs must have been obtained from some other animal, very likely its mother.

The calf was well nourished and as far as could be gathered in spite of its size, the ball produced no symptoms in the animal.

The diameter of the ball was 4 inches; weight was about 50 grams. The length of individual hair varied from 1 to 1·5 cm.

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January 27, 1946.

FLUORIDE INTOXICATION ANÆMIA IN CATTLE

ANÆMIA has been recognised as one of the clinical features of fluoride intoxication in animals and man. Several workers—Valjavec[5] (1813); Leake and Ritchie[2] (1926); Slagsvold[4] (1924); Roholm[3] (1937)—have studied the effect of fluoride salts on the blood-picture of animals; from the standpoint of clinical hæmatology, the available data do not clearly indicate the type of anæmia present. In none of these publications, moreover, has any reference been made to the possible correlation of blood changes to pathological processes elsewhere in the body. Thus the exact pathogenesis of anæmia induced by fluoride intoxication has escaped the attention of previous workers. The present note contains observations on these aspects arising from our studies on the pathology of experimental fluorosis in cattle.

Our interest in the study of this symptom-complex was prompted by finding certain pathological changes in the bones and the marrow of fluoride-fed animals. Pande[1] (1944) has shown that in cattle fed with NaF at the rate of 3 to 4 mgm. per kgm. body-weight, gelatinous degeneration of the bone marrow

occurs. The red marrow in the metaphyses of long bones and the ribs tends to disappear under the stress of abnormal disposition of young trabeculæ formed by metaplasia. Histologically, in these parts, active hæmopoiesis is absent and the marrow consists principally of reticulum and osteoblasts.

When compared with those of normal cattle, the number of the erythrocytes was low, the packed cell volume figures were approximately the same and the hæmoglobin content was reduced although the mean corpuscular values appeared to be higher both with regard to the mean corpuscular hæmoglobin and mean corpuscular hæmoglobin concentration. Cells representing immature stages in the development of the erythrocytes could not be found in stained preparations of blood.

Leucocytic count of the fluoride-fed animals was found to be unaffected. Cells characterised by the presence of nuclei of shapes varying from a band to a horse-shoe-shaped appearance were frequently seen and when determined by the peroxidase reaction were found to be young granulocytes. On differential count the lymphocytes were found to predominate over the neutrophils.

Among animals and man, fluoride intoxication causes a considerable damage to the marrow element; this in the case of domestic animals manifests itself as gelatinous degeneration, and as osteosclerosis in man and also in the rat. In both instances, however, the marrow loses its capacity for blood regeneration, and the consequent anæmia may thus be considered as aplastic in type when viewed from the point of pathogenesis. From the morphological standpoint, however, the fluoride intoxication anæmia of cattle, as investigated by us, is macrocytic and hyperchromic as the figures for the mean corpuscular volume fall within the normal range and those for the mean corpuscular hæmoglobin and the mean corpuscular hæmoglobin concentration are found to be higher than the normal values for cattle.

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Institute, Izatnagar,
December 24, 1945.

1. Pande, P. G., *Ind. J. Vet. Sc. & Anim. Husb.* (in press), 1945. 2. Leake, C. D., and Ritchie, G., *Am. J. Physiol*, 1926, **76**, 234. 3. Roholm, K., *Fluorine Intoxication*, H. K. Lewis, 1937, London. 4. Slagsvold, L., *Norsk. Veterinær-Tidsskr*, 1934, **46**, 2 (quoted by Roholm, 1937). 5. Valjavec, M., *Z. ges. Exp. Med.*, 1932, **85**, 382 (quoted by Roholm, 1937).

MANGO-SEED KERNEL—A NEW SOURCE OF FOOD

ACCORDING to a recent estimate the concentrates available in India are sufficient only for 29·1 per cent. and fodder for 78·5 per cent. of the adult bovine population. This does not take into account the requirements of goats, sheep and equines. The shortage is further accentuated during periods of famine. In order to meet these shortages, the Nutrition Research Laboratories at Izatnagar have been exploring new sources of foodstuffs. This investigation relates to the use of mango-seed kernel as a cattle and human food. At present, the material is thrown away as a waste. From chemical analysis of the kernels it has been found to be rich in protein, carbohydrates and fats (crude protein 8·50, ether extract 8·85 and soluble carbohydrate 74·49 per cent. on dry matter basis).

It was incorporated with the ration of bullocks to the extent of 50 per cent. of digestible protein. The animals took two to three weeks to acquire a taste for the kernels but later relished it. During the observation period of three months the animals gained an average of 33 lbs. in weight and also developed a healthy appearance and fine condition.

Results from a metabolic experiment on three country bullocks show that the animals were in positive balance with regard to N, Ca and P. The digestibility coefficients of crude protein, ether extract and soluble carbohydrates were 72, 56 and 70 per cent. respectively. The digestible protein and starch equivalent per 100 lb. dry matter of the kernel were 6·1 lb. and 67·5 lb. respectively. These figures can be favourably compared with other grains, *e.g.*, maize, barley and oats.

The observations merit mango-seed kernel a place in the category of food-grains and make available every year about 70 million pounds of digestible protein and 780 million pounds of starch equivalent from a hitherto unutilised source. It has also been calculated that the digestible protein obtained from 80 lb. of oats is equal to that of 100 lb. of mango-seed kernel and the starch equivalent from 86 lb.

The supplementary values of mango-seed kernel flour were found out by partial and total replacement of wheat and maize from the stock diets, by using rats as experimental animals. Observations were made to find out the effect on growth and reproduction of rats over a period of three generations. The biological values of protein, as determined by growth and balance sheet methods, show no declination when mango-seed kernel flour replaced 60 per cent. of the wheat or maize quota in the stock diets. The difference was, however, found to be significant when the wheat or maize was totally replaced by mango-seed kernel flour. The hæmoglobin, plasma protein, albumin|globulin ratio, non-protein-nitrogen content of blood and percentage of bone-ash show no significant difference between the stock diet and the mango-seed kernel groups. The liver vitamin A content was found to be higher in the mango kernel group.

The details will be published elsewhere in two parts.

Our grateful thanks are due to Dr. F. C. Minett for his constant advice and encouragement in the development of these investigations.

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January 19, 1946.

THE CARBOHYDRATE-LIPOID ENVELOPE OF THE LEPROSY GERM

As is well known the Tubercle bacillus does not lend itself to ordinary staining which is now recognised to be due to a wax-like lipid which envelopes this germ; the same is also true of the leprosy germ. Following the example of Pagel who stained the Tubercle bacillus with Giemsa stain[1] I wanted to do the same with the leprosy germ.

Smears of leprous nodules were first treated with various fixatives and then with Giemsa stain but the results were all negative. Even Carnoy's fixative, which contains 30 per cent. chloroform and as such should have dissolved the waxy envelope of the leprosy germ did not give satisfactory results. A large test tube filled with Carnoy's solution was kept in a beaker of hot water and the temperature raised until the Carnoy's mixture began to boil. Slides of smears from leprous nodules were transferred from the cold into hot Carnoy's solution and kept in it for half an hour. The slides were treated with different grades of alcohols and finally brought into water and stained with Giemsa. This procedure gave ideal results. Pure chloroform or its mixtures with alcohol did not produce any happy result even on boiling. Likewise mixtures of acetic acid and alcohols even on boiling did not give satisfaction. But chloroform and mineral acids provided the mixture is heated proved as efficient as Carnoy's hot mixture. The few experiments lead us to the conclusion that the leprosy germ has an envelope of a carbohydrate-lipoid nature. In order to hydrolyse the carbohydrate acid media are necessary and not merely acid but the solutions must be hot for hydrolysis takes place much more rapidly. Once the carbohydrate is splitted up the lipoid residue can be dissolved by a solvent like chloroform and heat.

This explains why three factors are necessary—acid, chloroform and heat.

The work is in progress and it is hoped that further details will be published in due course.

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Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
December 24, 1945.

1. Kayne, Pagel and O'Shaughnessy, *Pulmonary Tuberculosis*, Oxford Press, 1939, p. 4.

A LEAF-SPOT DISEASE OF 'JOWAR' (*SORGHUM VULGARE* PERS.) HITHERTO UNRECORDED FROM INDIA

FOR the last few years the senior author has been noticing a leaf-spot disease of *Sorghum vulgare* Pers., on the farms attached to the College. During the rainy season this year the authors noted that the disease is fairly serious in the villages near Cawnpore. This disease has, so far, not been recorded in India and appears fairly serious to warrant the attention of plant pathologists. The causal organism of the disease, so far not recorded in India, is *Titæospora andropognis* (Miura) Tai. The disease was first recorded by Miura in Manchuria and subsequently in the United States of America. A brief account of the disease has been given by Bain and Edgarton[1] and by Bain.[2]

At Cawnpore the disease is first noted in the third week of July when the crop is fairly young, and it assumes a virulent form during the end of August. The young lesions are elongate elliptic, visible on both surfaces of the leaf and 'naphthalene yellow' in colour. As they elongate the colour changes to 'Naples yellow' finally to 'cepusine buff'. As the spots mature the central portion begins to assume a darker colour, ultimately becoming grey surrounded by a 'flesh ochre' margin.[3] The colour of the margin becomes dark-red in fully matured spots. The central portion of the lesions assumes a sooty colour which is due to the initiation of subepidermal stroma. Later, numerous erumpent, spherical or subspherical black sclerotia appear on the surface; these are more prominently seen on the lower surface of the leaf and are easily brushed off. The lesions, specially those near the margin, coalesce together resulting in long streaks (Plate I). It is not unusual to find more than half the total leaf area affected. The average size of the individual lesions is 5 cm. × 1 cm.

PLATE I. Lesions caused by *Titæospora andropognis* on leaf of sorghum (× ½).

This disease has been described as the 'sooty stripe disease of sorghum' by Bain[2] who has quoted Miura's description of the fungus. According to Bain[2] it has not yet been determined whether the subepidermal black stroma is formed before or after sporulation.

Microscopic examination of the lesions showed that the tissue of the leaf is permeated with broad, hyaline, septate hyphæ which tend to be intercellular. The xylem vessels are often packed with broader hyphæ that assume a darker colour. The hyphæ accumulate in the substomatal cavity and develop dark

coloured sub-hemispherical stroma which is composed of isodiametric cells in the basal region, while the apical portion, *i.e.*, the side facing the stroma, consists of elongated cells of lighter colour. The apical region elongates and forces apart the guard cells resulting in a wide stomatal opening (Plate II, Fig. 1). The conidiophores develop on the apical portion of the stroma within the substomatal cavity and do not extend beyond the level of the guard cells, and are closely packed, hyaline, non-septate with a truncate apex measuring 22-35 × 3-3·5 μ. Their arrangement is reminiscent of a coremium. The conidia are borne at the truncate apex of the conidiophores and are cylindrical, flexuose, 1-8 septate, measuring 56-106 × 2-3·3 μ, but usually 65-75 μ long with usually one, and occasionally up to three, lateral branches measuring 16-35 × 1·7-3 μ (Plate II, Fig. 2).

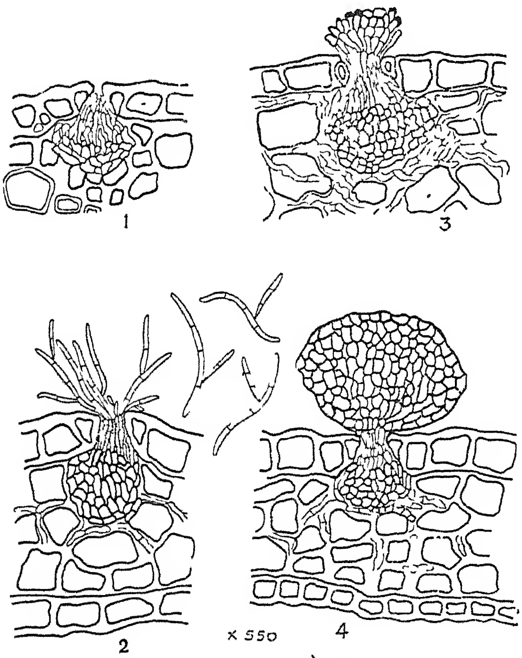

PLATE II. *Titæospora andropognis.* 1. Section of leaf showing the formation of the stroma in the substomatal cavity. Same showing the formation of conidiophores and conidia. 3. Conidiophores pushed beyond stomatal opening and the initiation of the sclerotium. 4. Mature sclerotium.

After the sporulation is over the subhymenial cells multiply and the hymenial portion of the stroma is pushed beyond the stomatal opening. The truncate apices of the conidiophores, thus pushed beyond the stomatal opening, become thick-walled and assume a dark colour (Plate II, Fig. 3) and cut off dark thick-walled cells ultimately expanding into a reniform or hemispherical sclerotium measuring 110-230 × 56-190 μ (Plate II, Fig. 4). The stroma is thus connected with the superficially formed sclerotium by a narrow column of pseudoparenchymatous tissue of elongated cells extending through the stomatal opening (Plate II, Fig. 4). As the sclerotia are superficially formed and not embedded in the tissue they are easily brushed off.

According to Bain[2] Miura has referred to these sclerotia as 'black bodies of unknown nature'. Bain also states that 'whether Miura's subepidermal black stroma is formed before or after sporulation is yet to be determined". Studies made by the present authors show that sporulation is not profuse and occurs on the surface of the substomatal stroma at a definite stage of its development. The sporulation period is very brief and is quickly followed by the development of the superficial sclerotia.

Further investigations on the morphology and pathogenicity of the fungus and its cultural characters are in progress.

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Cawnpore,
December 29, 1945.

1. Bain, D. C., and C. W. Edgarton, " Two leaf-spot diseases on sorghum and related grasses," *Phytopath.* 1942, **32**, 1. 2. Bain, D. C. " The sooty stripe disease of sorghum," *Phytopath*," 1945, **35**, 9. 3. Ridgway, R., 1912, *Colour Standidards and Colour Nomenclature.*

THE CHROMOSOMES OF *SACCHAROMYCES CEREVISIAE*

THE note on this subject which appeared in the last issue of *Current Science*, embodied the results of an exploratory investigation on the structure of the yeast-cell with particular reference to the chromosomes. There it was indicated that caution was necessary before accepting certain structures which were interpreted as chromosomes by previous workers.[1,2] Further investigation has placed us in a position to state definitely that these bodies are really the centrioles of the organism. While this was in progress, Lindegren's[3] paper suggesting the use of toluidine blue as a specific for the chromosomes of yeast appeared and it has now been possible to demonstrate that there are six pairs of

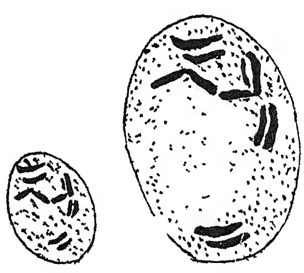


FIG. 1. × 3600 , FIG. 1 A. Enlarged

chromosomes in *S. cerevisiæ* (Fig. 1). The nucleus is a compound structure containing the hemispherical centriole intimately attached to the nuclear vacuole. A patch of chromatin is in intimate contact with the centriole. This chromatin which is plastered on to the centriole is responsible for the entire

structure to appear pink after treatment with decolourised basic fuchsin. Advantage has been taken of this fact to work out a differential staining technique in this laboratory. Smears of actively dividing cells are fixed in Lewitsky's mixture for three hours, washed, and subjected to mild acid hydrolysis. The slides are rinsed in distilled water and transferred to decolourised basic fuchsin where they are left for an hour. This treatment causes the centrioles to appear pink, and the slides are next treated with an aqueous solution of toluidine blue. Acid alcohol is used for differentiating and the smears are finally cleared in clove oil, left in xylol for a few minutes after which they are mounted in dilute neutral balsam. Preparations with pink centrioles and dark chromosomes are thus obtained (Fig. 2).

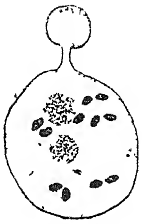


FIG. 2. ×3600

We have thus an improved differential staining technique for the nucleus of yeast by which we can secure differentiation of the centriole from the chromosomes.

In answering the long-disputed question of the nature of yeast chromosomes, we have raised a few fundamental and far-reaching problems. The yeast-cell obviously contains a small quantity of Feulgen-positive chromatin in association with the centriole and Feulgen-negative chromatin in the chromosomes. The latter is in keeping with the early belief that yeast nucleic acid is of the *d*-ribose variety. But then we know that this type of nucleic acid does not polymerise into long thin columns so characteristic of desoxyribose nucleic acid. This being so, one may ask how the nucleic acid is associated with the protein in the chromosomes. If genic action should depend on a zipper-like combination between the long columns of nucleic acid and the protein chains, we have a situation in the yeast chromosomes which demands a new explanation.

Department of Botany,
Central College,
Bangalore, K. V. SRINATH.
February 6, 1946.

1. Badian, M., *Bull. Int. Akad. Pol*, 1937, **B 1**, 1–5. 2. Subramaniam, M. K., and Ranganathan, B., *Curr. Sci.*, 1945, **14**, 3. 3. Lindegren, Carl C, *Mycologia*, 1945, **37**, 6.

TRANSPORT OF LIVE FISH IN OXYGENATED CONTAINERS

FOR an intensive development of our inland fisheries, an inexpensive method of transport of fry and fingerlings of fish is needed to stock extensively all the impounded waters, streams and rivers. Various kinds of appliances are at present in use in different parts of India such as earthen vessels or *Hardi's*, which are extensively in use in Bengal for the transport of "spawn" or larvæ, fry and fingerlings; glass containers, used by Mulligan and Majid[1] (1936) for transport of a dozen *Gambusia*, and open-tin containers of various designs used by the Madras Fisheries Department. It is only recently that closed containers with a supply of oxygen, similar to those in use on the Continent and in America, have been introduced in some parts of India[2] (Hamid Khan, 1939).

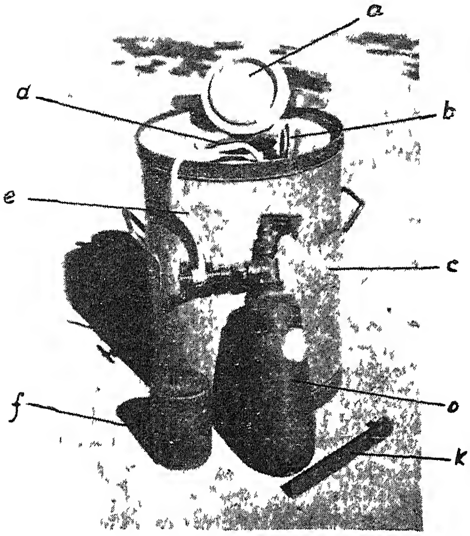
One of the essential features in the transport of live fish is the oxygenation or aeration of the water in which the fish are carried. In open carriers this is done either by change of water or by agitating the water with hand or pumping air into the container by a cycle pump.

The amount of oxygen consumed by fishes of different species varies considerably and the lower limit for dissolved oxygen in water upto which the fish can live is rather difficult to define as even that varies with the species of fish. Experiments conducted on the fry of Rohu (*Labeo rohita* Hamilton) and Mirgal (*Cirrhina mrigala* Hamilton) to determine the amount of oxygen consumed by them in a closed container show that, when the temperature of the water is 75° F., eight fingerlings, four to five inches in length, kept in a closed glass container, containing 8·17 litres of water with 3·316 c.c. per litre of dissolved oxygen, consumed 2·977 c.c. per litre of oxygen in 100 minutes. The fingerlings at the end of the experiment turned upside down, and when removed from the container, only two of them revived when transferred to fresh water. In another experiment, when twelve fingerlings had been kept for 65 minutes, the lethal point was reached when oxygen dissolved in the water was reduced to 0·364 c.c. per litre. Each fingerling had consumed 0·246 c.c. per litre of oxygen in 65 minutes[3] (Hamid Khan, 1940).

Oxygen container.—The results of these investigations have been utilized in the transport of carp fingerlings in the Punjab to long distances in closed containers with sufficient supply of oxygen to last for more than 12 hours. The container, measuring 18″× 14″, is made of galvanised iron sheet. It is cylindrical in shape and has all its joints soldered air-tight. There are two openings at the top, one 5 inches wide and another 2 inches, both provided with air-tight screw-stoppers (Fig.). The smaller opening leads into an open tube of galvanised iron, 3 to 4 inches in length. The container, when in use, is filled to the brim with water. The fingerlings are introduced and then the larger stopper is closed tightly. The oxygen is then blown through the smaller opening. Water is displaced upto the length of the inner tube by the pressure of the oxygen. The smaller opening is then tightly screwed on. The fish thus have an atmosphere of oxygen upto 3 or 4 inches. The oxygen gets dissolved in the water when the container is in transit by the jolting movements of the train or the lorry.

The capacity of the container to hold the fry or the fingerlings varies with the distance to

be travelled, the duration of the journey, the temperature of the water and the amount of oxygen dissolved in it. For a distance, which



Oxygen fish-container (c) with oxygen cylinder (o).
a = Screw stopper of larger opening.
b - Screw stopper of smaller opening.
d = Large opening
e = Rubber tubing leading into smaller opening through which oxygen is blown.
f = Cover of oxygen cylinder.
k = Key to open-srcew stopper (b).

can be covered within 12 hours, in winter, each container can hold 200 fry of 1 to 2 inches length, 100 fingerlings of 3 to 4 inches in length, or 30 to 50 yearlings of 5 to 8 inches in length.

The average mortality of fingerlings and yearlings during transit has so far ranged from 2 to 4 per cent.

The cost of the container in pre-war days was Rs. 16 each, and even with rough handling it lasted for more than ten years. The oxygen is available at a cost of one or two annas per cubic foot, which is sufficient to fill two carriers. No special attendant is needed and no change of water is required *en route*. The introduction of these carriers for transport of fingerlings in the Punjab has reduced the cost of transport to more than half of what was previously incurred on transport in open carriers. The oxygen containers have been in use in the Punjab for the last ten years and have given quite satisfactory results.

Warden of Fisheries,
Punjab, Lahore,
December 12, 1945. HAMID KHAN.

1. Mulligan, H. W., and Majid, A., *Rec. Malaria Surv. India*, 1930, **6**, 4, 537–47. 2. Hamid Khan, *Seasonal Notes, Punjab Agricultural College, Lyallpur*, 1939, **18A**, 2, 41–42. 3. —, *Ind. Journ. Vet. Sci. and Anim. Husb.*, 1940, **14**, 372-81.

A NEW SPECIES OF GENUS *TRICHURIS* FROM CATTLE AND BUFFALOES

THE species described in the paper was collected mixed with *Trichuris discolor* from Mukteswar, Izatnagar and Sialkot on five occasions. More than fifty cattle and buffaloes were examined for this purpose alone in the localities mentioned above. Fæcal examination of dairy animals at Izatnagar revealed *trichurids* to be absent in adult animals but calves of about one to one and a half years of age always passed eggs in their fæces. It is possible that age plays an important part in infestations with *trichurids* of cattle and buffaloes. The number of parasites in each collection varies from fifteen to forty and only include the species under description and *T. discolor.*

Trichuris indica sp. n.

Male.—Length of anterior part 34-38 mm.: length of posterior part 11-12 mm.; and maximum breadth of the parasite 0·3-0·42 mm.

The spicule (Fig. 1) resembles in general that of *T. globulosa* in being robust and pos-

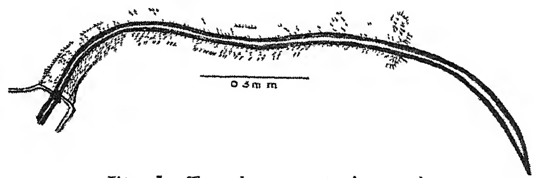


FIG. 1. *T. indica*, posterior end.

sessing 'flares' at the anterior end. It tapers down posteriorly in a more or less sharp point unlike the hyaline tip described for *T. globulosa* by the author (paper in press). In length the spicule measures 3·4-4 mm. and breadth in about the middle is 0·022-0·285 mm.

The posterior swollen part of the sheath is not fully everted in any of the specimens. The length of the tubular proximal part is 1·1-1·3 mm. and the spines on it measure 0·0075-0·009 mm. The spines on the distal swelling of the sheath measure 0·018-0·020 mm.

There is a conical papilla on either side of the posterior end of the body (Fig. 1).

The testis starts behind the beginning of the cloaca, is straight in the region of the ejaculatory duct but is convoluted in that of the vas deferens. The length of vas deferens is from 3·5-5 mm.; that of the ejaculatory duct from 2·65-3·7 mm.; and that of cloaca 2·23-2·7 mm. with the spicular tube joining it 1·52-1·9 mm. from the posterior end.

Female.—Length of anterior part is 36-42 mm., while that of posterior is 8·5-11 mm.

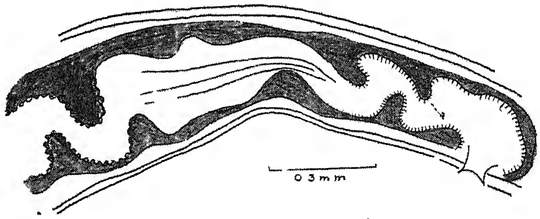


FIG. 2. *T. indica*; vagina.

The vagina has two proximal curves communicating with a dilatation posteriorly through a narrow passage of uniform calibre measuring about 0·3 mm. long. The muscular prolongation (*a*) divides the proximal two cavities, the first cavity being twice as capacious as the second one. The cavities are lined by spines. The eggs including opercula measure 0·068-0·072 mm. long and 0·034-0·375 mm. broad.

Host.—*Bos indicus* and *Bos bubalis*.

Location.—Cæcum.

Locality.—Sialkot (Punjab), Izatnagar and Mukteswar-Kumaon (U.P.).

Specific diagnosis.—Trichurids having spicules 3-4·4 mm. long and 0·022-0·0225 mm. broad and ending in a more or less sharp point. Body carrying a papilla on either side of its posterior part with a sheath having spines which on the distal swelling are more than double the size of those on the proximal part.

Vagina having two curves in its beginning, the first being twice as large as the second one. The curves being followed by a passage of uniform calibre and which expands to form a dilatation posteriorly. Eggs measure 0·068-0·072 mm. long and 0·034-0·0375 mm. broad.

Cæcum, cattle and buffaloes, Sialkot (Punjab), Izatnagar and Mukteswar-Kumaon (U.P.).

Discussion.—This species differs from all other epecies of the genus *Trichuris*, with the exception of *T. globulosa*, by its possessing larger spines on its posterior bulb of the sheath than on its anterior tubular part. It differs from *T. globulosa* by the possession of a papilla on either side of the posterior end, the spicule ending posteriorly in a more or less sharp point and not a hyaline tip preceded by sabre-shaped part. The vas deferens and ejaculatory duct in the author's species are about half the size of those of *T. globulosa*. In *T. globulosa* there are angular beds in the proximal part of vagina and the neck following the beds immediately expands into a dilatation. In the author's species angular beds and neck are absent. The fact that the collections were made from different localities at different parts of the year and all the individuals in all the collections present constant features, is significant.

Department of Food,
Government of India,
New Delhi, M. M. SARWAR.
October 1, 1945.

1. Baylis, H. A., "Three Notes on Parasitic Nematodes," *Ann. Mag. Nat. Hist. Ser.*, 1932, No. 10, **10**, 497-502. 2. Ortlepp, R. J., "Whipworms from South African Ruminants," *Ond. Jl. Vet. Sci. Anim. Ind.*, Union of South Africa, 1937, **9**, No. 1. 91-100.

PHYSIOLOGY OF EXCRETION IN EARTHWORMS

IN an important memoir on the Physiology of Excretion in Earthworms (*Quarterly Journal of Microscopical Science*, Oxford. Vol. 85, Pt. IV, September 1945), Prof. K. N. Bahl of the University of Lucknow gives a very interesting and instructive account of his experiments and observations. He finds that the earthworm voids its excretory products as ammonia and urea and that there is no trace of uric acid in its urine. Ammonia and urea are first formed in the body-wall and gut-wall and are passed on to the blood and cœlomic fluid, whence they are eliminated by the nephridia. In fact, ammonia and urea have been estimated for the first time in the blood, cœlomic fluid and urine of an earthworm. Since the blood contains excretory products, the current view that blood is merely a carrier of oxygen has been proved to be untenable. In order to determine the role of the nephridia in osmotic regulation, the author has carefully estimated the osmotic pressure and the protein and chloride contents of blood, cœlomic fluid and urine, and has come to the conclusion that an earthworm, when submerged in water, can live like a fresh-water animal when both its gut and nephridia act as osmo-regulatory organs; but in the soil the earthworm lives like a terrestrial animal and the osmo-regulatory function adequately discharged by its nephridia alone, which reabsorb proteins and chlorides and conserve water. The mechanism of excretion has been clearly analysed into processes of filtration, reabsorption and chemical transformation. The significance of the phagocytic section of the nephridium has baffled many a previous worker, but Prof. Bahl, by making a spectroscopical examination of a solution of brownish excretory granules in pyridine, has conclusively proved that the colouring matter of these granules is the blood-pigment "hæmochromogen", and that the phagocytic section is really a "storage kidney" storing the destructive products of blood.

We might only add that not only has he obtained valuable results but that the technique he has devised for collecting adequate quantities of blood and urine is equally remarkable, as it was this difficulty which had so far made analyses of these fluids impossible.

S. L. HORA.

REVIEWS

Photosynthesis and Related Processes. By Eugene I. Robinowitch. Vol. I. (Interscience Publishers Inc., New York, N.Y.), 1945. Pp. 559. Price 8.50 dollars.

The author is a well-known worker in the field of Photochemistry and is now a member of the Solar Energy Research Project Committee of the Massachusetts Institute of Technology. A comprehensive treatise on Photosynthesis by an expert of his standing will remove a long-felt want. The present volume is divided into two parts.—I. The Chemistry of Photosynthesis and Related Processes and II. The Structure and Chemistry of the Photosynthetic Apparatus. In the treatment of the subject, much of the older work which are of doubtful value has been omitted but those that are of historical importance and enduring influence have been discussed in detail. All recent literature up to 1943 have been incorporated in this book with a critical insight, and the author has not hesitated to express his views on the merits and defects of the experimental technique, the conclusions, and hypotheses developed by research workers now investigating this fascinating but almost baffling problem. It is estimated that 20×10^{10} tons of carbon are annually fixed on earth by photosynthesis. Hence the importance of an accurate knowledge of the mechanism of this process is obvious. We are yet, however, far from the goal, *i.e.*, fixation of carbon outside the living cell with the aid of solar radiation and plant pigments.

Observations made by Rubens and co-workers, using for photosynthesis, carbon dioxide and water containing radioactive carbon and heavy oxygen, have proved beyond doubt that the oxygen evolved in photosynthesis comes from water alone and that carbon dioxide is incorporated in the dark into a large molecule of the plant material probably forming a carboxyl group. Such definite conclusions are, however, rare But, as the author says, "during the last twenty years, some important new avenues of approach to the study of photosynthesis have been opened. Mention may be made for example, of oxygen liberation by isolated chloroplasts; of the broader view of the chemistry of photosynthesis by the study of bacteria; of the discovery of the possibility of changing the chemical course of photosynthesis in certain algæ by substituting new substrates for carbon dioxide and water". The use of flashing light, new experimental procedures for rate measurements by sensitive physical methods, new knowledge of the structure of the photosynthetic apparatus, detailed chemical examination of the chloroplasts, extensive application of the methods of enzyme chemistry—all these promise rapid progress in this field. The author has done well in emphasising these newer trends in the study of photosynthesis and has produced a book which will be a standard work of reference for anyone interested in the subject.

The reviewer recalls with pleasure the interesting discussion he had with Professors Franck and Gaffron in Chicago a year ago on these new developments. The book bears the impress of the spell which these two path-finding investigators have also cast on the author.

J. C. Ghosh.

Dynamic Meteorology. By Jorgen Holmbe, George E. Forsythe and William Gustin, Department of Meteorology, University of California at Los Angeles. (John Wiley and Sons Inc., New York; Chapman and Hall, Ltd., London.) Price 4.50 dollars.

Here is a book which every student and professor of meteorology should welcome. It is an ideal and up-to-date text-book for the advanced student. Written in the traditions of the Norwegian School it reveals how thoroughly the weather forecaster was trained in the U.S.A. during the war. In this volume the authors deal with the major aspects of "Dynamic Meteorology". Naturally, topics like instrumental technique, descriptive aspects of synoptic meteorology, atmospheric turbulence and radiative phenomena are omitted. The treatment of the subjects actually dealt with is condensed and logical. By following an admirable system of cross-references repetitions are completely avoided. The book is self-contained and by the use of vector methods the theoretical treatment of atmospheric motion and circulation is handled with brevity and elegance.

The book is divided into twelve chapters. The first is devoted to dimensions and units. The next two deal with the thermodynamics of dry and moist air respectively. After discussing hydrostatic equilibrium in the earth's atmosphere and its stability (chapters 4 and 5) the authors proceed to discuss the problems of atmospheric circulation in the remaining seven chapters. In Chapter 10 the authors have included their discussion of the theory of cyclones which appeared in the *Journal of Meteorology* recently (1944).

The book deserves a place by the side of other recent treatises on meteorology like *Physical and Dynamical Meteorology*, by D. Brunt; *Weather Analysis and Forecasting*, by S. Petterson; and *Dynamic Meteorology*, by B. Haurwitz. The authors deserve to be congratulated for bringing out a volume which is sure to be a companion to every serious student of theoretical meteorology. We recommend it to all progressive Universities in India which have introduced or intend to introduce an advanced course in Meteorology for the M.Sc. degree.

L. A. R.

The Organic Chemistry of Sulphur: *Tetracovalent Sulfur Compounds*. By Chester Merle Suter. (New York: John Wiley & Sons, Inc., London; London: Chapman & Hall, Ltd.), 1944. Pp. v - 858. $10 00.

We now look to the U.S.A. for those comprehensive, if uncritical, reviews of literature, *Handbucher, Enzyklopadien*, once a product of German assidutiy. The organic chemistry of sulfur has a copious but scattered literature, which has been very little collated, and a new volume on the subject cannot fail to be of interest.

The book under review deals, as its sub-title indicates, only with those "compounds which in a broad sense are derivatives of sulfuric acid". Its scope may be indicated by quoting the seven chapter headings: "I. Esters of Sulfuric Acid, II. Aliphatic Sulfonic Acids, III. The Preparation of Aromatic Sulfonic Acids, IV. The Properties and Reactions of Aromatic Sulfonic Acids, V. Derivatives of Aromatic Sulfonic Acids—1. Sulfonyl Halides, Esters and Anhydrides, VI. Derivatives of Aromatic Sulfonic Acids—2. Sulfonamides and Related Compounds, VII. Sulfones." This ground has been previously covered, less exhaustively, by J. Halberkann and F. Fretwurst in a monograph *Sulfonieren* (published in 1929 as a part of Abderhalden's *Handbuch der biologischen Arbeitsmethoden* -Abt. 1, Chemische Methoden, Teil 2, 2 Halfte, heft 3,, s. 1969-2104), a work not easy of access and to which no reference appears in the present volume. The bibliographies of the seven chapters are extensive. A small "test check" of references was possible, as the reviewer happened to have prepared some time ago a reasonably complete bibliography relating to Sulphonyl Halides, Esters and Anhydrides, and he is able to add nothing essential to the author's survey.

Due attention is paid to those products which have practical applications, though the treatment of sulphonated oils is brief and Burton and Robertson's book *Sulfonated Oils* (1939) is not mentioned. Chapter VI includes good accounts of saccharin, sulphohaloamides and sulphanilamide with a useful discussion of methods of estimation.

A more complete account of sulphones could hardly be found elsewhere and some curious recent observations are duly noted, including that of the occurrence of dimethyl-sulphone in cattle blood and adrenal glands (1940). The triboluminescence of sulphobenzide might have been mentioned; this appears to be a property of only one of the allotropic forms described by Bogert in 1936 and is worth investigation.

Only a few unimportant inaccuracies have been noticed, such as errors in proper names. The index—mostly to compounds mentioned in the text—is constructed on the *Chemical Abstracts* method; occasional inconsistencies occur, mesitylenesulphonyl chloride appearing also as trimethylbenzenesulphonyl chloride, *p*-anisidine-sulphonic acid as 5-amino 2-methoxybenzenesulphonic acid, whilst these duplications do not appear in other cases. These are, however, small points and the labour of the indexer must have been so considerable that the reviewer hesitates to suggest that German assiduity would have proved a *Namen-vezeichniss* also!

In his short preface, the author disarmingly suggests that the preparation of a second volume to cover "the remainder of sulfur chemistry" will depend on "the interest of organic chemists in this type of monograph and other demands on the author's time". The interest of organic chemists need not be in doubt; the present volume must find its place in all adequate chemical reference libraries. The coming of peace may have removed the other obstacle by reducing alternative demands on the author's time. It may be suggested, however, that a single volume will hardly suffice to deal with the remainder of the subject on the scale of the present one; the heterocyclic compounds of sulphur will almost certainly find themselves relegated to a third volume.

In the meantime, we have Connor's useful survey of organic sulphur compounds in Volume II of the second edition of H. Gilman's *Organic Chemistry*, and we are promised an A.C.S. monograph by E. E. Reid. What is needed, besides the undoubtedly valuable work of the collator or compiler, is a critical account of the subject in relation to modern theories of organic chemistry, on the lines of Sidgwick's classic treatment of the organic compounds of nitrogen.

Wokingham, REGINALD CHILD.
September 16, 1945.

Plants and Plant Sciences in Latin America. Edited by Dr. Frans Verdoorn, Ph.D. (The Chronica Botanica Co., Waltham, Mass.; Messrs. Macmillan and Co., Ltd., Calcutta), 1945. Pp. xi + 384, with 83 plates and text-illustrations. Price $6.00.

It is unnecessary to stress the need for greater international collaboration in the study of plant sciences. A constructive programme towards this end, however, had not been seriously thought of till now. As a help in this direction, the *Chronica Botanica* authorities have recently published an account of the vegetation and natural resources of Latin America together with a survey of the present condition and the future possibilities of a number of branches of plant sciences in that region, whose problems are not merely of local but of international importance.

Dr. Frans Verdoorn himself contributes an introductory essay entitled, "The Plant Scientist in the World's Turmoils", in which he has dwelt upon the importance of an international understanding of plant sciences and how best this can be done. The book contains contributions from nearly 100 authoritative writers, the contributions dealing with each politically delimited localities of Latin America. Most of the contributions are written up in English but about 18 are in other languages as Spanish, French and Portuguese. The entire book is divided into two parts. The first part contains primarily articles not previously published whereas the second part contains reprints of articles already published in the pages of *Chronica Botanica*.

The first part opens with the chapter, "Problems of Tropical American Agriculture",

After devoting the next three chapters for phytogeographic sketch, principal economic plants, and historical sketch, which are of general botanical interest, regional descriptions follow. About 25 politically delimited regions of Latin America have been treated by experts and each individual exposition is encloprædic. Further, there are about 23 titles dealing with botanical subjects of general interest concerning Latin America but on a regional basis. Of these, "Hevea Rubber Culture in Latin America; Problems and Procedures" by Dr. R. D. Rands, "Notes on Cinchona Culture" by Dr. W. Pennock, "Aims, Scope and Future of Research on Fibre Plants in Latin America" by Dr. B. B. Robinson, deserve careful study by every botanist. Of particular interest is the special supplement, "Plant Breeding, Genetics and Cytology in Latin America" by Dr. C. A. Krug. To an Indian botanist this is specially welcome, as he is also confronted with many pressing problems concerning the improvement of Coffee, Cinchona, Rubber, etc.

A large portion of the second part is again devoted to about 15 regional descriptions. Though many of the regions treated in this part overlap those in the first, information contained is by no means a repetition. A list of "Travel Books of Botanical Interest", "List of Collectors in the West Indies, Central America and South America" and the special supplement, "Plant Institutions, Stations, Museums, Gardens, Societies and Commissions in Central and South Americas" which is comprehensive and up to date has come as a very handy tool to every naturalist, collector or researcher, who is anxious to contact his co-workers.

The illustrations for the book have in many cases been selected from classical publications; and a careful study of some of them rouses curiosity in the reader as to the history of plant sciences. Of particular interest are the end-pages illustrating the vegetation of Latin America picturesquely. The size and get-up of the book conform to the familiar style of the *Chronica Botanica* series. While recording our sincere admiration for the work of the authorities, we would also express the hope that through their efforts similar compendiums dealing with the plants and plant sciences of other countries may soon become available to students of botany.

B. G. L. S.

Fungicides and Their Action—*Annales Cryptogamici et Phytopathologici*, Vol. II. By James G. Horsfall. (Messrs. Chronica Botanica Co., Waltham, Mass., U.S.A.), 1945. Pp. 239. Price $5.00.

Yet another excellent publication has appeared in the new series of *Annales Cryptogamici et Phytopathologici*. Large number of books on Fungicides have been written in the past, but the present one is a departure from the normal in that it very ably combines fundamental knowledge with the applied aspect of the problem. Astounding progress has been made during this century in the field of fungicides, particularly on the organic side. In all these studies, intensive and extensive, statistical interpretation of experimental data accruing out of each experiment has put the subject on a sound and sure footing. What we needed at the present moment was a critical review of the position to-day as far as "Fungicides and their Action" were concerned. This task has been most admirably accomplished by Dr. Horsfall, who, for over fifteen years, has built up a sound school of "Plant Chemotherapy."

The chapters of laboratory assay; some problems of data assessment; principles of chemical protection; coverage of single and multiple surfaces; artificial immunization and chemotherapy; action of copper, sulphur; action of organic nitrogen compounds, etc., have been very well written. The reviewer was particularly attracted by the chapter on "Artificial immunization and chemotherapy". This chapter on chemotherapy is written, as in the case of other chapters, with up-to-date literature on the subject. The work in this line by the discovery of antidoting the toxin of Dutch elm disease by using diaminoazobenzene dihydrochloride, 8-hydroxy-quinoline sulphate and malachite green, has opened out a new avenue of research. Further, other promising chemicals in this line are mentioned, *viz*., urea, hydroquinone and many others where their basic nitrogen might have been responsible in part for the antidoting action. In this connection, ascorbic acid, a substance with strong reducing properties, was injected into egg-plants sick with the wilt fungus *Verticillium albo-atrum*. The wilted plants showed recovery. Perhaps, even more promising than the above examples is the work on inactivation *in vivo* of the virus disease known as X-disease of peach. This again was done by urea, calcium 8-hydroxyquinolate, etc. All this suggests that the instance quoted here of *in vivo* inactivation of plant virus is due to either oxidising or reducing of the toxin to an innocuous level.

The other chapter written very ably is the one on "Action of organic nitrogen compounds". It would be impracticable to go into the details of this chapter within the course of this review. On the whole, this well-got-up publication would attract considerable attention from both pathologists and organic chemists who work on this most fascinating field of fungicides and their action. The reviewer unreservedly recommends this volume to the researchers and students of botany or phytopathology who wish to have the latest and most trenchant views on the subject of fungicides.

T. S. SADASIVAN.

A Changing Social Structure (being a collection data submitted to *ad hoc* Committee appointed by the Conference of Trusts), 1945. By Sapur F. Desai, Joint-Secretary, Parsi Panchayat, Bombay. Pp. 59.

This brochure has been prepared from the information collected by Mr. Desai for submission to the *ad hoc Committee* appointed by the conference of charity trust to deliberate on different problems of the Parsis. It deals with such problems as health, nutrition, unemployment,, education, housing and organisation of the Parsis who are one of the most important

communities in the Province of Bombay. Much of the brochure is naturally taken up with tables which in many cases cover statistics for the forty odd years of the present century. The author has no doubt presented the available data objectively, as far as possible and nowhere indulged in wide generalisation. The study of this privileged and gifted community can, however, hardly give an adequate idea of the problems facing the entire community. For example, the low birth-rate and death-rate noticeable among the Bombay Parsis in the last decade could hardly be taken as an index of the population trends even in Bombay city as a whole and conclusion based thereon. The entire data collected for the Parsi community can, however, be useful in determining the tendencies of the more advanced communities and in suggesting remedies for the more unhealthy trends. The social structure of the Parsi community has undergone gradual changes in the direction of progressive urbanisation with all that it involves. The tables prepared show how the numbers of unmarried persons have gone up four times during the last fifty years (1881-1931) while the number, of married people has gone down by half during the last twenty years. In education, Mr. Desai notices the trend towards Science and Technical Courses while Agriculture, Law, Engineering, Medicine and Teaching seem to be losing charm for the Parsi boys. In regard to health and nutrition, the general standard of the Parsi community is much higher than other classes of population. The huge amounts spent by the Parsi community on charity in the shape of doles for the poor members of the community and in providing cheap accommodation for poor families in Bombay are unequalled by any other class of the population. The trustees of the Parsi Panchayat also run an unemployment bureau which is able to help most of the persons capable of being employed. On the whole Mr. Desai has given us good statistical information about the Parsi community although one would have wished him to have given a more extensive analysis of the "changing social structure" and ways and means by which the undesirable tendencies could be checkmated.

The Effect of Activity on the Latent Period of Muscular Contraction. By Alexander Sandow. (Published in the *Annals of the New York Academy of Sciences*, Volume XLVI, Arl. 3, pp. 153-154.)

The minute mechanical changes occurring during the latent period of muscular contraction have been recorded by a highly sensitive device consisting of a piezo-electric, cathode-ray oscillographic technique which, with great reliability, permits determining the activity induced latency time differences of the order of several 0·1 ms. and length differences of about 0 05 μ. The results obtained have been highly interesting. The effect of activity on the various variables occurring during the latent period has been obtained. These changes are correlated in some detail with activity induced pH changes, studied in other investigations. This correlation and several other implications of the data are shown to be confirmatory evidence for a previously advanced hypothesis that the latency relaxation is a mechanical sign of a tension-induction process involving mechano-chemical coupling of myosin and adenosine triphosphate in the form of an enzyme-substrate combination, during the existence of which the myosin is energised and activated for contraction.

I may here point out that in smooth muscle, it is quite common to see an initial relaxation preceding a contraction, when the muscle is stimulated with alternating current, potassium, adrenaline, nitrate, thiocyanate, etc., as published in my papers in the *Journal of Physiology* and the *Proceedings of the Indian Academy of Sciences*. This initial relaxation decreases with increase of pH, as in skeletal muscle, so that it appears that the two are related.. I have postulated that it is due to release of calcium. INDERJIT SINGH.

CHROMOSOMES AND EVOLUTION*

SYNTHESIS should follow analysis and nowhere is a synthesis more difficult than in Cytogenetics. To get the correct perspective the whole field has to be viewed from the evolutionary standpoint. Though chromosomes form the common "mechanical and physiological denominator" of plants and animals, evolution has proceeded in entirely different directions.

It is said that the majority of angiosperms could be traced to polyploid ancestors. Duplications of either individual chromosomes or of whole sets, thus appear to have played a major role in the evolution of new species in plants. Polyploidy is so rare in animals that it appears very doubtful whether they have any role at all in speciation. "It was pointed out by Muller (1925) that in bisexual organisms polyploidy will inevitably upset the sex-chromosome mechanism, since it automatically abolishes heterogamety. Thus a tetraploid of an originally XY : XX form will have the composition XXYY : XXXX and nearly all the gametes of the originally heterogametic sex will be XY (due to the two X's and the two Y's forming separate bivalents at meiosis). So that even if a tetraploid male and female meet and pair they would stand no chance of starting a tetraploid race" (p. 181).

And again it is very doubtful whether the well-known type of genetic system of higher plants, allopolyploidy, exists in animals at all. All the metazoan polyploids appear to be autopolyploids. "The distinction between auto- and allopolyploidy is not, of course, an absolute one, and if a doubling of the chromosome number followed on crossing between the two

* *Animal Cytology and Evolution* By M. J. D. White. (Cambridge University Press), 1945, Pp. 375 + viii. Price 36 *sh.* Net.

sub-species or strains of the same species it would be difficult to decide whether the resulting form should be called an auto- or an allopolyploid. If any allopolyploids exist in animals they are probably borderline cases of this kind" (p. 305).

Under the circumstances we find chromosome studies playing an important role in plant breeding. Since hybridisation and polyploidy have played a major role in evolution of plants, chromosome studies have become essential for any corrct appreciation of the phylogeny of especially the economically important plants.

Thus while animal cytology is little used by taxonomists and others, it is work on Drosophila which has given us our modern genetical conceptions. The rapid strides in the cytology and genetics of Drosophila has made "Drosophily" a separate branch of biology. Unconsciously a barrier has arisen between students of Drosophila and cytologists and geneticists interested in other groups of organisms. "Thus the former are frequently ignorant of not an inconsiderable amount of cytological work which has been carried out on Orthoptera, Vertebrates, etc.; while conversely, those who have worked on the cytology of grasshoppers or mammals, are often woefully ignorant of Drosophila genetics".

It is doubtful whether at the present day any single person could present a balanced synthesis of our knowledge of the genetical and evolutionary cytology of animals and plants. Dr. White, therefore, deals in the book under review only with the evolution of animal chromosomes mainly with a view to "close up the cleavage between Drosophila workers and general cytologists".

The phenomenal advance in Cytogenetics during the past one decade is mainly due to the rediscovery of the salivary chromosomes in 1933. Their use in genetic investigations and analysis of. wild populations has resulted in a reorientation of the older concepts. "Once again as in the time of Weismann, the chromosomes are coming to occupy the central place in physiological and evolutionary thought, only this time we know vastly more about their detailed structure and genetical behaviour in a great variety of animals and plants. By studying salivary gland chromosomes it is possible to make direct comparisons between the gene sequences of different individuals and species with an ease and precision previously undreamed of. It is now more than ever apparent that it is quite impossible to analyse the mechanism of evolution without taking into consideration structural rearrangements of chromosome parts" (p. 3).

As a result of intensive investigations the chromosome sets are assuming a new significance. "The newer conception of the chromosome as an organized body whose parts stand in definite functional relationship to one another has replaced the crude and atomistic idea of a row of entirely independent chromomeres like beads on a thread. The view that changes in chromosome number can take place by simple 'fragmentation' and 'fusion' died when it was realized that each chromosome possesses a centromere, and that centromeres do not arise *de novo* but only from pre-existing centromeres (Navashin, 1932). Thereafter it was clear that an increase in chromosome number must involve duplication of a centromere together with a region (large or small) around it; while a decrease in chromosome number must involve permanent loss of a region containing a centromere. Thus both increases and decreases lead to concomitant changes in the total amount of genetic material, and must hence be expected to produce genetical changes, quite apart from the position-effect. Whether these laws apply to groups like the Heteroptera and Homoptera, where centromeres cannot be detected cytologically is still uncertain; but there can be no doubt that they apply in the vast majority of organisms" (p. 152).

It is being increasingly realized that the function of a gene depends on its position in the gene sequence and that any alteration of its position alters also its properties. "Although in the present state of our knowledge, it is difficult to make general statements about the rather diverse phenomena included in the term position effects, it is clear that they are all expressions of the continuity of the chromosome. In the early days of Drosophila genetics the emphasis was entirely on discontinuity (effects of single genes conceived of as discrete units). More recently certain writers such as Goldschmidt have swung to the opposite extreme, thinking that all genetical phenomena should be regarded as expressions of a continuous molecular pattern in the chromosomes and that all mutations are nothing but position effects resulting from minute structural rearrangements. The truth, for Drosophila at any rate, would appear to lie somewhere between these extreme view-points. For, maize, on the other hand, the older view-point seems to be almost completely true, since no undoubted position effects are known, in spite of the fact that a number of structural rearrangements have been studied. Perhaps, the 'internodes' between the genes are longer or at any rate more completely devoid of genetic properties than they are in Drosophila (pp. 310-11).

The discovery that structural rearrangements could be induced by diverse agencies such as temperature shocks, chemicals and irradiation is now being increasingly exploited. Since the breakages produced by the above diverse agencies appear to be similar, planned experiments have been carried out with a view to analyse the changes in gene sequence which might have occurred in the course of evolution.

A phenomenon comparable to duplication of chromosomes came to light as a result of investigations on salivary chromosomes. These are the *repeats*—duplications of small segments of chromosomes. The evolutionary significance of these repeats seem to be considerable. It appears that "the repeated regions represent an important kind of 'raw material' for future evolution, and that the evolutionary potentialities of an organism depend, in the long run, partly on the extent and kind of repeats in its chromosomes. This is, of course, mere speculation—but it is in accordance with

what is known of the genetics of polyploids in plants (Haldane, 1930)" (p. 48).

Just as segments get repeated, segments of chromosomes may get deleted also. Though in the main deficiencies reduce viability it appears as if some genes could be deleted with impunity. "The longest deficiencies known to be viable in the heterozygote include about 50 bands. In very rare instances flies homozygous for a small deficiency may be viable (Bridges, 1938; Panshin, 1938)" (p. 49).

It is probable that there may be considerable differences of opinion regarding some of the speculations presented in the body of the book such as that "in the X_1X_2Y group the translocation probably *took place at least as long ago as the Miocene* and possibly earlier. The large number of X_1X_2Y species in Africa and Asia suggests that *it took place somewhere in the Old World*", etc., etc. (p. 254). These are merely bold guesses which every author has the right probably to indulge in !!

One wonders whether the name of the hermaphrodite polychæte mentioned on page 288 is spelt properly !

The species problem still remain elusive. This is not surprising since the extensive studies on Drosophila on the above problem from all conceivable angles brought home the fact that it is very difficult to clearly distinguish species from sub-species! We have yet to discover the relative roles of the various agents in speciation.

The author has to be congratulated for his excellent account.

M. K. SUBRAMANIAM.

SCIENCE NOTES AND NEWS

THE INDIAN SCHOOL OF MINES, DHANBAD

Big demands for admission into the Indian School of Mines, Dhanbad, and for the services of qualified Coal Mine Managers are recorded by the annual report of the Working of the Indian School of Mines, Dhanbad, for 1944-45. 2,518 Candidates sought admission into the School in 1945 as against 2,183 in 1944 and 1 335 in 1943. Of these, 394 were selected for the entrance examination after which 43 were enrolled as students for 1945 46.

Students of the Indian School of Mines during the session 1944-45 fared well, as usual, in their examinations. Six out of the ten successful candidates in the examination for the first-class Coal Mine Manager's Certificates were I.S.M. students, and the first three places were also secured by them. Out of 26 who came out successful securing second-class Coal Mine Manager's Certificates, 21 were from the I.S.M. and ranks 1 to 14 also went to them. The I.S.M. got 15 out of 59 passes in the Mine Surveyor's Certificate Examination. Only one failed out of the 23 candidates sent up to the examination for the diploma of Associateship in Mining Engineering and in Geology, while all the 20 candidates who appeared for the examinations for Certificates in Coal Mining and in Geology passed.

Research work was carried on in the washability and grading of coal. X-ray examination of Indian coals was continued and three original papers on geological subjects were contributed by the staff. The total number of scholarships held by students during this year was 71.

1851 EXHIBITION RESEARCH SCHOLARSHIPS

The Royal Commissioners for the London Exhibition of 1851 have offered to award annually two Science Research Scholarships of the value of £350 per annum for students from Indian Universities or Institutions having post-graduate departments of science. The scholarships are post-graduate and are intended to enable the selected students, who have already completed a full University course and whose record indicates a high promise of capacity for advancing science, to devote themselves to research work for two years.

Provincial Governments and Local Administrations have been asked to invite recommendations from Universities and Institutions for the scholarships to be awarded in 1946 and to forward them to the Government of India by March 31, 1946.

Candidates must be British subjects, or British protected persons, being subjects of Indian States, and should be below the age of twenty-six years on May 1, 1946. Applications of candidates above the prescribed age will be considered only under very special circumstances. A period of War Service will be regarded as 'special circumstances'.

No application from a student residing in India or abroad will be considered unless it is recommended by the authorities of a University or Institution in India.

University of Madras, Notification.—Applications are invited for the appointment of Director (Professor) of the Research Laboratory in Zoology on a salary of Rs. 750-50-1,000.

Applicants should be graduates of Indian or British Universities with high academic qualification and should have sufficient experience of research work. A knowledge of Marine Zoology will be an additional qualification. Last date of application: 1st June 1946.

Applications are invited for the post of a Lecturer in Statistics on a salary of Rs. 210 per month in the grade of Rs. 210-15-300.

Applicants must possess a First or Second Class Honours Degree in Science, Mathematics, or Economics with post-graduate qualification in Statistics, if this subject did not form part of the Degree course, and have research experience. A research degree in Statistics will be an additional qualification. Last date of application: 15th March 1946.

Fellowships for Research in Physics and Chemistry.—With a view to encouraging re-

search in Chemistry and Physics, the Imperial Chemical Industries, Ltd., have established Fellowships in the University of London. The Fellowships will be awarded for original research in Chemistry, Physics, Engineering, Metallurgy, Pharmacology and Chemotherapy.

The Fellowships are open to persons of either sex. They are normally of the value of £600 a year and will be tenable for a period of three years in the first instance. A Fellow will have to take a limited part in the teaching of the Department in which he works.

This year the Fellowships will be tenable from October 1946 but applications from candidates now on National Service who cannot take up appointment to the Fellowship until later will also be considered. Detailed Regulations and Application Forms can be obtained from the Academic Registrar, University of London, at the Senate House, London, W.C. 1. The last date by which applications should reach at this address is April 30, 1946.

University of Madras Endowment Lectures, 1946-47.—The Syndicate will proceed shortly to select persons to deliver lectures under the following endowments for the year 1946 47. Applications for lectureships will be received by the undersigned not later than the 1st March 1946. Applicants are requested to give full particulars regarding their qualifications and the subject selected by them for the lectures. The lectures are to be delivered before January 1947. Separate application should be submitted for each lectureship.

The principal terms and conditions of award are given below:—

(1) *The Maharaja of Travancore Curzon Lectureships*: Three lectureships of the value of Rs. 250 each, relating to (a) Medicine (Clinical), (b) Engineering and (c) Agriculture. Applicants should be graduates of the University.

(2) *The Sir Subrahmanya Ayyar Lectureship*: Value Rs. 250. The lectures should be on a subject connected with Natural Science. Applicants should be graduates of the University.

(3) *The Gokhale Lectureship*: Value Rs. 250. The lectures should be on a subject connected with Indian Economics. Applicants should be graduates of the University.

(4) *The Sankara Parvathi Lectureship*: Value Rs. 250. The lectures should be on a subject connected with Ancient South Indian History. Applicants should be graduates of the University.

(5) *The Sir William Meyer Lectureship*: Value Rs. 1,500. A course of not less than six lectures should be delivered on a subject in History. Half the remuneration will be paid after the delivery of the lectures and the other half after the publication of the lectures.

(6) *The Principal Miller Lectureship*: Value Rs. 350. A course of not less than two lectures should be delivered on a subject dealing with the exposition of the Inner Meaning of Human History as disclosing the One Increasing Purpose that runs through the Ages, with special reference to Indian History or Indian Culture.

(7) *The Dr. Elizabeth Matthai Lectureship*: Value Rs. 300. A course of not less than three lectures should be delivered on a subject embodying the results of original investigation in some branch of Medicine and Surgery. Preference will be given to a subject having special reference to the requirements of women and children.

(8) *The Rt.-Hon'ble V. S. Srinivasa Sastri Lectureship*: Value Rs. 300. The lectures should be on a subject connected with the study of Political Science with special relation to India.

(9) *The Rt.-Hon'ble Sir George Stanley Lectureship*: Value Rs. 350. A course of three or more lectures should be delivered on any topic comprised in Æsthetics.

(10) *The Dr. Annie Besant Memorial Lectureship*: Value Rs. 300. The lectures should be on a subject connected with Politics or Civics or Sociology or Religion or Philosophy or Ethics or Education or Fine Arts.

For further particulars regarding the lectureships, please see University Calendar, Vol. I, Part I, 1945-46 (Appendix F).

National Institutes of Sciences of India.—At the Annual General Meeting of the National Institute of Sciences of India held at Bangalore on the 1st January 1946, the following were duly elected Officers and Members of its Council for 1946:—*President*: Mr. D. N. Wadia, New Delhi. *Vice-Presidents*: Sir S. S. Bhatnagar, Delhi; Prof. H. J. Bhabha, Bombay. *Treasurer*: Dr. B. C. Guha, New Delhi. *Foreign Secretary*: Sir J. C. Ghosh, Bangalore. *Secretaries*: Rai Bahadur S. L. Hora, Calcutta; Prof. D. S. Kothari, Delhi. *Editor of Publications*: Dr. J. N. Mukherjee, New Delhi. *Members of Council*: Dr. Bashir Ahmad, New Delhi; Prof. K. N. Bahl, Lucknow; Dr. S. K. Banerj, New Delhi; Dr. Verrier Elwin, Patangarh, C.P.; Brigadier E. A. Glennie, Delhi; Khan Bahadur M. Afzal Husain, New Delhi; Prof. M. O. P. Iyengar, Madras; Prof. K. S. Krishnan, Allahabad; Prof. P. C. Mahalanobis, Calcutta; Dr. B. N. Prasad, Allahabad; Dr. H. S. Pruthi, New Delhi; Prof. M. Qureshi, Hyderabad (Dn.); Dr. L. A. Ramdas, Poona; Rai Bahadur J. M. Sen, Krishnagar; Professor M. R. Siddiqi, Hyderabad (Dn.); Lt.-Col. S. S. Sokhey, Bombay; Dr. A. C. Ukil, Calcutta.

ERRATA

Vol. 15, No. 1, January 1946:

Page 20, line 2, *for* pu *read* ρ_u; line 4, *for* $2\rho_v/1 + \rho_v$). *read* $2\rho_v/(1 + \rho_v)$; line 42, *for* Narayan *read* Narayanan.

Page 29, Review of the book "Selected Topics from Organic Chemistry", column 2, line 1, *for* help- *read* helpful. Between lines 17 and 18 the correct formulæ should *read* as follows:

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CURRENT SCIENCE

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THE SCIENTIFIC INSTRUMENT INDUSTRY

THE scientific instrument industry has been universally recognised as one of the "key" or the "pivotal" industries, essential for the promotion of research and indispensable for the development, improvement and standardisation of other industries. The spectacular services which the industry rendered during the war have augmented this recognition and raised its prestige. The industry has played a fundamental role in the development of the modern weapons of war, almost human in its operational skill and unerring in the pursuit of its target. Great ingenuity and resourcefulness have been displayed in the instrumentation of industrial machinery and industrial processes. This has led to an all-round rationalisation of industry contributing towards a degree of precision which had not been attained before and securing an enviable measure of economy of time and man-power; these constituted vitally important gains for the war effort.

Instrumentation has accelerated the speed of research; it has been responsible for eliminating physical strain and fatigue in scientific work and for effecting a considerable reduction of the personal and accidental errors incidental to experimental investigations. Improved instruments have facilitated and enlivened the teaching and the demonstration of the principles of science; the industry provides the tools for the training of scientists and technologists needed for the creation, expansion and maintenance of industries. Scientific instruments group themselves into (1) instruments for purposes of instruction and demonstration in schools and colleges, (2) those needed for pure and applied research, (3) those which are essential for the control of industrial machinery and technological processes, (4) those which are employed in the standardisation of industrial products, and (5) those connected with problems of national defence, and thus encompass every phase of our national life and existence.

For practically every type of instrument India is dependent upon foreign supplies; our national contribution to the science of instruments and instrumentation has been regrettably insignificant. During the war, scientific investigators in this country became painfully conscious of the heavy price the nation had to pay for having, in the past, neglected to develop this key-industry. Just at a time when the Government launched upon a programme of intensive research and industrialisation the scientists found themselves faced with an embarrassing shortage of the essential tools of research, whose supplies have since become increasingly scarce. The scientists themelves, we are afraid, must largely accept the responsibility for this critical situation, since the development of a scientific instrument industry is their exclusive privilege. It is instructive to recall that in the early days of scientific enquiry, scientific men made their own instruments and later, the rise of the instrument industry in Germany and England was closely associated with historic men of science. Far-sighted governments, like that of Germany,

extended their support to the industry and helped to establish intimate collaborations between scientists and manufacturers. One of the most classical of such collaborative enterprises, famous in the history of scientific instruments, is the one which the German Government brought about between Prof. Abbe and the firm of Schott in Jena. In the early days of the last war, the British Government created a Department of Scientific and Industrial Research; the very first task which the Department took up was the problem of rejuvenating the industry of scientific instruments and of the optical and laboratory glasses, through both of which the essential tools of research are forged. The instrument industry in Britain has, in recent years, occupied a privileged position in its national economy; although its direct economic importance is relatively small, its indirect value is recognised to be out of all proportion to its size. The status and prosperity of the scientific instrument industry of a nation, is accepted to constitute a true measure at once of the efficiency and advance of scientific education and research as well as of the economic stability and technological excellence of its manufacturing industries.

The responsibility for the disheartening backwardness of the scientific instrument industry in India should be shared by four groups of agencies; first by the Government who have not encouraged the establishment of this key industry; secondly by the scientists and technologists who have not organised themselves and secured a self-sufficiency for the country with respect to the essential tools and accessories for scientific education and research, thirdly, by the industrial manufacturers who have not yet become sufficiently instrument-minded to lend their support to the industry; and fourthly, by the trading firms who should undertake the responsibility of creating an indigenous manufacturing industry in the country. During the war, a few enterprising firms have tried to establish the nucleus of a manufacturing industry; they have worked under great difficulties and severe handicaps; their heroic and sincere attempts to serve the scientific workers during the war years will be gratefully acknowledged.

The present appears to offer a propitious moment for launching upon a five-year plan for the development of this industry and in accomplishing this task all the four agencies should participate and co-operate; the Government by extending their financial support and offering tariff protection, the scientists by placing their experience at the disposal of the industry and through research, the industrialists by encouraging the instrumentation of their industrial equipment and processes and the trade by organising the manufacture of instruments in their own workshops.

The universities and the research institutes can play an extremely inspiring and constructive role in contributing to the development of the industry; they can inaugurate courses in applied physics with special reference to scientific instruments and industrial instrumentation; they can initiate research on fundamental and applied aspects of scientific instruments. The Council of Scientific and Industrial Research has already financed quite a few schemes which have a direct bearing on the manufacture of scientific instruments. The National Physical Laboratory will, we have no doubt, include a section for the study of scientific instruments. Polytechnic Institutes which are expected to come into being in the next few years, might appropriately offer facilities for training in precision mechanics, instrument design and instrument making; these institutes should be able to provide a continuous flow of competent technical personnel for the instrument industry. The immediate needs of the industry with respect to precision mechanics could, however, be met by a selection from among the "Bevin Boys", and the hundreds of skilled personnel trained in the Ordnance Factories, Munition Workshops and the Hindustan Aircraft Factory. The skilled labour which has been developed during these war years should not be allowed to languish and the scientific instrument industry and the fabrication of chemical plant, if started, could absorb almost the entire quantity of skilled labour now threatened with retrenchment.

With a view to speed up the progress of the industry, it may be advisable to entertain, for short periods, the services of a few top-ranking specialists experienced in this line, who would undertake to train some of our young men during the period of their contract. Large number of such experts from Germany have gone to Britain and America and it is reported that several hundreds of them have been 'removed' by the Russians. A few may still be available in Germany and other parts of the war-devastated Europe; they would eagerly accept an invitation from this country with gratitude and undertake to assist us in developing this industry. The task of choosing these experts may well be entrusted to a Technical Mission which should be deputed to England, America and Germany, who should also be entrusted with the task of studying the industry in all its bearings, and of securing the necessary capital equipment. The Technical Mission should be composed of the instrument-minded and active scientists, creative engineers and shrewed businessmen connected with the instrument trade.

In an editorial on the Scientific Equipment Industry, the *Journal of Scientific and Industrial Research* (1944, 2, 75) entered a strong plea for a pooling of the experience acquired by the scientific workers; it was suggested that the information thus made available should be edited and published and a five-year plan drawn up for making the country self-sufficient with respect to the scientific instruments and laboratory chemicals. We earnestly hope that our leading men of science will take up this task immediately and secure the generous support of the Government for establishing this key industry on a broad and enduring foundation.

THE UNDERGROUND GASIFICATION OF COAL IN THE U.S.S.R. ITS POSSIBILITY IN INDIA

By M. R. MANDLEKAR

(Fuel Laboratory, Department of Chemical Technology, University of Bombay)

Introduction

ALTHOUGH credit is due to Mendeleev (1888) for the first suggestion that coal may be gasified *in situ*, and to Ramsay (1912) who had actually proposed to carry out the work on an experimental scale at a Colliery in Durham, but which was subsequently abandoned due to the outbreak of the World War (1914), it was mainly due to the interest taken in the scheme by the Soviet Government that some preliminary experiments were subsidised (1931). The work was later included in their five-year plans and the scheme has been in operation in certain Russian coal basins on an industrial scale.

References have been made to the method in literature but it is only recently that more information in this regard has been available. Jolley and Booth (*Fuel in Science and Practice*, 1945, 24, 31) have surveyed the literature on this subject.

It is interesting to note that the method has been made applicable to coal beds which are difficult or unprofitable to work by ordinary mining methods owing to the low grade of coal, tendency to spontaneous combustion, thin seam, and other reasons. The outstanding features of the scheme have been described in the article. The principal methods are outlined below.

Methods

The 'Bore-hole-producer Method' is suitable for horizontal or slightly inclined seams, especially if the roof is porous or unstable. For this purpose two galleries are constructed within the seam to serve blast-inlet and gas-offtake manifolds; the galleries are connected by a number of parallel bore-holes. Shafts (about 2 ft. diameter) for blast and gas are constructed to connect the galleries to the surface. The coal panel is ignited and the fire spreads gradually yielding lean or rich gas according to the composition of the blast (with or without oxygen).

For the operation of the 'Stream Method' two or more galleries, following the dip of the seam, are joined by a horizontal gallery. A panel may have more than 12,000 tons of coal. Fire is lighted in one of the panels and blast (enriched with oxygen) is supplied through a shaft. The combustion zone advances upwards towards the roof and the accumulated ash and any material from the roof do not readily block or engulf the unburnt coal. A principal feature of the method is the small number of labourers required for underground operations.

The 'Percolation (or Filtration) Method' depends on the formation of shrinkage cracks and fissures in the coal when heated, so that it becomes readily permeable to gas. A number of bore-holes, arranged in concentric rings, are made and blast and gas-pipes are fixed in them. The coal at the bottom of one of the holes is ignited and the combustion is maintained by supplying air and/or oxygen through the blast pipe. The gaseous products formed develop fissures in the coal mass allowing them to pass up through the adjacent openings.

In addition to the above main systems a number of combinations suitable under different working conditions have been practised. During the progress of the operations precautions have to be taken to check the spread of fire by constructing brick walls in the underground galleries. The shafts have to be suitably lined. There are a number of other operations requiring careful observation and control and for a number of them mechanical controlling devices have been adopted.

Advantages

It has been claimed that underground gasification enables the full value (80-90 per cent.) of the coal to be won, whereas even highly mechanised mining methods enable only 60 per cent. of the coal worked to be utilised.

Low quality producer gas (100-150 B.T.U./cu. ft.) is manufactured in the process; however, in certain cases with the use of oxygen (from neighbouring chemical works) in the blast the quality of the resulting gas is improved. It is even suggested that the gas could be stripped of its hydrogen content which may be utilised for the synthesis of liquid fuel by the Fischer-Tropsch process and for the synthesis of ammonia required for the fertilizer industry.

The gas is mainly used for the generation of electric power, for the synthetic chemical industry, and for domestic purposes. In all these fields the results achieved have been very favourable in comparison to the practice of commencing initial operations from mined coal. Giant power stations have been constructed whereby drastic saving has been effected in labour and costs. It is stated that the average output per man employed was increased from 30 tons of coal per month by mining methods to the thermal equivalent of 100-120 tons per month in the underground gasification scheme. While formerly about 70 per cent. of the labour employed in Russian coal mines was engaged in underground operations, in the underground gasification stations only 15 per cent. is necessary. On thermal basis the labour requirement of the underground gasification station is 5-6 times less than in coal mine.

The cost of production of lean gas (100-150 B.T.U./cu. ft.) has been stated to amount to about 0·375-0·5 pence per therm (100,000 B.T.U.) and that of rich gas (250 B.T.U./cu. ft.) to 1·0 pence per therm. The capital cost of an underground gasification plant is 60-70 per cent. of that of a plant employing above-ground producer. For a combined underground gas-electric power generating station the capital cost is given as 1,500 roubles per K.W. installed power (*i.e.*, about £60) and the

prime cost of power as 4-6 kopek per Kw. hr., *i.e.*, about 0·4-0·6 pence per kw. hr.

POSSIBILITY IN INDIA

The new scheme has been largely developed during the war and it is expected that the coal basins wherein the underground gasification stations are situated would provide the centres round which the large scale industries of Russia would be developed. In India ambitious plans of industrial development are under consideration and preparation. As a preliminary step provision of cheap power is to be ensured. In those parts of the country where coal deposits are occurring, *e.g.*, Bengal, Bihar, Hyderabad (Deccan), Central Provinces and certain Central Indian States, plans for the erection of giant thermal power stations are being probably prepared so that cheap power may be available in the coal areas wherein would be located the large-scale industries of the respective provinces. The projected power stations perhaps may have been designed to utilise mined (inferior quality) coal. The success achieved by the underground gasification methods, in the U.S.S.R., should not be overlooked by the authorities concerned in this country.

It is necessary to stress that the coal resources of this country are limited and, in the light of the experience gained in Russia, low grade coal (some of which has been regarded as unprofitable to mine) and, an appreciable proportion of it, may be fruitfully utilised in the interest of the country.

Note.—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India. *Ed.*

MUSEUMS ASSOCIATION OF INDIA*

THE Museums of India, which, as those elsewhere, have been victims of great havoc during the war, are now being gradually restored to their normal condition. Various organisations, such as the International Museums Office at Paris and others, have already resumed work and are drawing up plans for the promotion of human culture, and it is hoped that the Museums Association of India will associate itself with such organisations.

Reference should be made here to the sad demise of Mr. Manindranath Dutta-Gupta, in whom the Taxila Museum has lost a most devoted Curator.

The Association has successfully started the publication of its own Journal, and it is hoped that in addition to the two numbers of the Journal in a year, a separate brochure on museum administration will be issued in the near future. Another noteworthy activity of the Association was to draw up a comprehensive questionnaire on topics relating to museum reconstruction. While some museums have given answers conducive to museum improvement, many of the smaller museums and those under the Government of India have remained indifferent to the questionnaire, scarcely realising that the attainment of a high standard depends largely on their contacts with non-official associations.

While, in India, the growth of museums has been intolerably slow, in America and Russia, museums not only increase rapidly in size and numbers but are also inextricably linked up with visual education. Indian museums will greatly benefit themselves by actively participating in an universal educational drive. Labelling, again, presents more difficult problems in India than in other countries, and it is often necessary to have labels written in four or five languages. The present moment is particularly opportune for strengthening the museum movement in the Madras Province, for the Madras Museum had its origin here exactly a hundred years ago and it is most fitting that the completion of the five year developmental plan of the Superintendent should mark its centenary. A special exhibition may also be held on the occasion, for exhibitions are of great educational value and museums should endeavour to direct such occasional outbursts of activity into more permanent channels. Another essential function of the Museums Association is to arrange for exchange of exhibits for the mutual benefit of museums; though historical museums may be unwilling to part with original specimens, provision may be made for exchanging duplicates, models and casts, and the Association has already made a beginning in executing such schemes.

The progress made by the museums in India during the last year has been considerable. The Baroda Museum has started issuing a six-monthly bulletin, while projects of establishing Regional Museums in different cultural centres are taking shape.

Standardised training for museum personnel is another important task of the Museums Association. For the present the opening of regular training courses for museum work in this country would be too premature, but curators may be materially benefited by working in the Archæological Survey and in the various sections of the first-rate museums in the country. It is also desirable to co-operate with the British Museums Association in this connection.

Finally, a word of thanks is due to the curators of different museums for their whole-hearted support and especially to Dr. B. C. Law, the scholar-philanthropist of Calcutta, who has recently become a donor of the Association.

S. THOMAS SATYAMURTI.

* Abstract of Rao Bahadur K. N. Dikshit's Presidential Address to the Second Annual Meeting of the Association, Madras, 1945.

RESEARCH IN DAIRYING*

PROF. H. D. Kay, Director of the National Institute for Research in Dairying, who is on a short visit to this country gave an interesting talk on the recent developments in Dairy Science, with special reference to his work in England. Outlining the origin and development of dairy research in Great Britain, he described the present relationship of the Dairy Research Institutes to the Agricultural Research Council and to other Institutes dealing with various aspects of the agricultural and industrial research. The National Institute for Research in Dairying at Reading is closely associated with the University of Reading but enjoys a good deal of autonomy and is administered by its own governing body. Co-ordination of work within the Institute is secured by a small professional Staff Committee comprised of senior members of the research staff. In addition to permanent members of the staff, post-graduate research students and visiting research workers from overseas are engaged in the various departments of the Institute on special problems. At present, five Departments exist, *i.e.*, Husbandry, Physiology, Bacteriology, Chemistry and Nutrition. In addition, a new section, the Dairy Machinery Section, is likely to reach departmental status very soon. Between them these departments cover the wide range of Dairy Science, breeding, feeding and management of dairy cows for milk production on the one hand and methods of milk distribution and even of keeping milk in the consumer's home on the other.

Dr. Kay described a few of the research problems which had been dealt by the Institute in the recent past and present. He pointed out the direct importance to the whole community of knowledge obtained of the effect of feeding and other controllable factors on the nutritional and other qualities of the milk produced. He gave an account of recent work on the control of milk quantity and quality by means of hormones and the methods by which milk had been produced from virgin and from barren animals. As regards Dairy Technology, improvements in methods of pasteurisation and the control of heat-treated milk were described. The desirability of making use of bacteriological advice in the devising and improvement of dairy appliances and dairy machinery of all kinds was emphasised. A number of problems concerned with the chemical composition of milk had been tackled and solved within the past few years. A recent and interesting finding had been that underfeeding of cows that had taken place in some districts in Britain during the war years had resulted in a fall not only in the volume but also in the nutritional quality of the milk produced. Objective methods of assessing the quality of dairy products by direct measurement of their physical characteristics had also been developed. Dr. Kay thought that in every Dairy Research Institute a Nutritional Section, where the nutritional value of milk and constituents of milk could be accurately assessed by chemical, physical and biological methods was a necessity. He also illustrated the need for the closest collaboration between the staff of the dairy research organisations dealing with specialist subjects which in many cases had an important bearing on the progress in dairy science. In his view there was a large number of unsolved dairy problems peculiar to India, in milk production, in the handling and processing of liquid milk and also in the making of Indian dairy products and in the utilisation of by-products. If these problems remained unsolved, they would continue to handicap severely the production and consumption of milk and milk products in this country and in consequence, the nutritional status of the population. It was clear that one of the most important national tasks facing India was to ensure an increased production and consumption of milk and milk products of really satisfactory quality.

* Abstract of a lecture delivered by Prof. H. D. Kay, C.B.E., D.Sc., F.R.S., on the 11th March 1946, at the Imperial Dairy Research Institute, Bangalore.

THE LATE MR. KAPILRAM H. VAKIL, M.Sc. (Tech.), F.I.C., F.C.S.
A PERSONAL ESTIMATE

By S. G. SASTRY

IT was at the palatial and hospitable residence of Sir Lala Shreeram that I last met Mr. Kapilram Vakil. The occasion was the second meeting of Panel on Heavy Chemical Industries of which he was a member and Sir Lala, the Chairman. Just before lunch, all the guests had gathered in the verandah. It was given to me to discharge a very pleasant social duty. To Sir T. S. Venkataraman, the celebrated sugarcane expert, I had the privilege of presenting the late Mr. Kapilram Vakil as "the Doyen of heavy chemical industries in India". The two heroes clasped each other's hands and were beaming at each other and exchanged thoughts and ideas--so much so that Sir Lala had to gently remind them that lunch was waiting.

The incident narrated above indicates the estimate in which I held the late Mr. Kapilram. For nearly thirty-five years, he laboured in the field of chemical industries in India,—specially heavy chemical industries—as a pioneer. He went through all the vicissitudes and tribulations that beset the path of a pioneer in any country, the more so a pioneer in the field of heavy chemical industries in India. When I entered the field as a fellow-worker, Mr. Kapilram had already ten years of solid work to his credit. He welcomed me as a brother. On many an occasion when we

had to differ we sparred at each other like devils but, thank God, our friendship did not suffer. My admiration and respect for him continued unabated. We had not many opportunities to meet each other but we exchanged letters fairly often. The respect due to an elder brother and a desire to defer to his experience and counsel always formed the background of my relationship with him and he reciprocated with affection and helpfulness towards an aspiring younger brother. It was lucky for him and lucky for India that the famous house of Tatas extended their hand of help towards a newcomer in the field of industrial chemistry and chemical engineering which was not very popular at that time in Inda, and probably so, even in England. In that country chemical industries existed and flourished. But research chemists and chemical engineers were looked upon with suspicion, if not disfavour. Germany and America were forging ahead in the field of chemical industries but England was resting on her oars and content to reap the profits of an Empire trade. It was at such a time that Mr. Kapilram Vakil made his debut before industrial India chaperoned by the famous house of Tatas.

His first efforts were in the field of oil industries. He contributed his share of work in the planning and starting of the Tata Oil Mills, Ernakulam. He was one of the earliest chemical engineers in India to think of hydrogenation of oils and fats and conducted several experiments personally on a plant scale. He published a paper on "Hydrogenation Flavour" (*Chemistry and Industry*, Review Section, 1923, pp. 788-90) which was widely noticed and reviewed in the technical press and the researches that followed the publication of this paper did much to ultimately remove the hydrogenation flavour from hardened oils meant for edible purposes. But the publication of this paper made the Indian industrialists a little more cautious. The Tatas, however, ventured to put up a plant at Ernakulam but it had to be closed down after sometime in spite of the heroic attempts of Mr. Kapilram. It is unnecessary to recount the history and progress of "Tomco" with all its ramifications in the field of oil production, soap-making, hydrogenation of oils and fats and glycerine production. They are well known in India. Mr. Kapilram Vakil contributed his share for the success of these enterprises continuously.

That he was basically an industrial chemist and turned his knowledge into many useful channels is proved by the fact that he contributed a very valuable report on the bye-products of wood distillation to the Government of Mysore who were then projecting the Mysore Iron and Steel Works. This report was printed in 1920 and obviously it was meant for private circulation. As an Industrial Chemist and Chemical Engineer who later on had to spend some of his time at the Mysore Iron and Steel Works I had the privilege of going through the report. With the knowledge then available to chemical engineers, no better or abler report could have been submitted taking all the relevant local factors into consideration in relation to the international competition in the field of production and sale of methanol, acetic acid and other bye-products of wood distillation. I am preserving a copy of this report and before writing this paragraph, I re-read the same much to my personal benefit.

Perhaps the most outstanding contribution in the field of chemical industries in India made by Mr. Kapilram Vakil is in the utilisation of salt and the byeproducts of the salt industry. For nearly quarter of a century, he dedicated his life to this branch of heavy chemical industry and undaunted by early failures and difficulties, he achieved a degree of success for which no more monuments are required than the Dhrangadhra Alkali Works and the Tata Chemicals at Mithapur. There was a time when table-salt was being imported from such far off places as Spain and England. Mr. Kapilram Vakil made up his mind that the salt industry should be established in India and started his first manufacture at Kharagoda. The success of Kharagoda enterprise encouraged others and now, a dozen or more similar companies are working successfully. But it was the basic work of Mr. Kapilram Vakil that led to this satisfactory development. Manufacture of magnesium chloride from the salt bitterns at Kharagoda and elsewhere must go to the credit of Mr. Vakil as also the manufacture of bromine from sea water. It will not be an exaggeration to state that Mr. Kapilram Vakil is the father of the salt industry in India.

The love and respect in which Mr. Kapilram Vakil was held by his own staff of officers and men can be proved by the following two extracts from the address presented to him on 28th May 1943 on the occasion of his sixtieth birthday:

> "Some of us present here recall that when you came here seventeen years ago, this place was a veritable desert over-run by cactus bushes and infested by reptiles. In less than two decades, with the encouragement from the Baroda State and the enterprise of the House of Tatas, you have transformed the desert into a modern industrial town where hundreds of people to-day earn their daily bread ..."

> "In the works at Mithapur, we see to-day the culmination of your work extending over the best part of your life. This could not have been achieved had it not been for the breadth of vision, boldness of conception, tenacity of purpose and untiring energy which you have displayed and which should be a source of inspiration and an example to all of those who are associated with you ..."

In my own humble way I have been somewhat of a pioneer in the field of development of chemical industries in the State of Mysore. I know from personal experience the hardships that a newcomer has to face and the disappointments he has to put up with. There are moments and situations so heart-breaking that one feels like abandoning the project. Time and again, ideals will have to be revived and the struggle recommenced. We have to swallow our pride and we have to pocket our self-respect. The only thing to do is to summon all the patience and perseverance at our

command once again and try to persuade the powers that be that the industry we are recommending is worthy of all the trouble and is in the best interests of India. Mr. Kapilram Vakil was a hero in this respect. If he was convinced that a particular enterprise was good and worth fighting for, he fought like a Trojan. Even in technical and scientific matters, in committees and other places, he was a very tough man to get on with because he was very staunch and unrelenting when he was fighting for an idea which he believed was true. He was very strict and austere in committees but immediately afterwards at the lunch table, his sweet smile would await you and one would feel the warmth of his human qualities. That was my experience. I am sure there are hundreds who would confirm this estimate of him.

OBITUARY

SIR UPENDRANATH BRAHMACHARI, Kt., M.A., M.D., Ph.D., F.R.A.S.B., F.N.I.

(1873—1946)

WITH the death on February 6, 1946, at his Calcutta residence, at the age of 73, of Doctor Sir Upendranath Brahmachari, Indian medical world has lost its doyen, one who will long be regarded as one of the most versatile and colourful personalities of modern scientific medicine in India. When Chemotherapy, which first originated with Erhlich in Germany (1908), did not even make its far-reaching influence felt in many progressive Western countries, Brahmachari's imagination and initiative attracted him to this most fruitful branch of Pharmacotherapeutics, and through patient and indefatigable work with almost primitive laboratory facilities at his disposal, he succeeded in discovering a specific (Urea Stibamine) for Kala-azar (*Visceral Leishmaniasis*), which not only saved millions of lives in his own country but also in many areas in the Near and Far East where the fell disease played havoc with human lives (mortality rate, including complicated cases, was recorded as 99 per cent. Following discovery of Urea Stibamine and other specifics, it is stated to be reduced to 1 to 2 per cent.).

Upendranath was the son of late Dr. Nilmoni Brahmachari, a medical practitioner of Jamalpur (District Monghyr), where he was born on December 19, 1873. Early during school career, young Brahmachari showed intelligence and capability of a high order. Following a brilliant career at the school, he joined the Hooghly College from where he took his B.A. Degree with Honours in Mathematics. Then he enrolled himself as a post-graduate student in the Presidency College, Calcutta, and from there took his M.A. Degree in Chemistry obtaining a first class. Here came a turning point in his career. His father, who was a medical practitioner, insisted that his son should go in for Medicine, while he himself desired to follow up the academical line, where his knowledge of chemistry and mathematics would stand him in good stead and enable him to probe into newer fields of knowledge. It was fortunate that the father prevailed, and young Brahmachari ultimately joined the Calcutta Medical College. He passed the L.M.S. (1898), and M.B. (1899) examinations standing first both in Medicine and Surgery. He then joined the Bengal Medical Service and was posted at the Mitford Hospital, Dacca, where, within a comparatively short time, he built up a wide practice and though still young, made a name for himself as a physician of great merit. In spite of his growing popularity and the ever-increasing demand made on his time by patients, he managed to keep his academic activities alive. In 1902, he obtained his M.D., a rare achievement in those days, and within the next two years, secured the PH.D. Degree by submitting a thesis on "Studies in Hemolysis", which remains even to-day a first-class study of the physiological and physico-chemical properties of the Red Blood Corpuscles. In the early part of this century, there was probably no other medical graduate in India who combined in himself a Science Doctorate with a Medical Doctorate.

In 1905, Brahmachari came to the Campbell Medical School, Calcutta, as Teacher of Medicine and remained in this Institution until 1923. From 1923 to 1927, he became the Additional Physician to the Calcutta Medical College Hospitals,—the first non-I.M.S. physician to be so honoured—and after retirement, took up the honorary post of Professor of Tropical Medicine at the Carmichael Medical College, and Professor of Biochemistry at the Calcutta University, which duties he continued to perform until his death.

Brahmachari's most important work, and for which he is so universally known (discovery of Urea Stibamine), was done while he was associated with the Campbell Medical School. Gifted with a keen, inquisitive and analytical mind, he did not fail to take early note of the difference between the two disease entities—Malaria and Kala-azar—which were usually confused in those days for want of laboratory and microscopic data. He was impressed with the fact that while quinine would afford relief in cases of malaria, it would not touch kala-azar cases, who slowly but surely succumbed in spite of the best treatment that could be given to them at that time. The only measure which afforded some promise of relief was the administration of antimony salts in the form of sodium or potassium antimonyl tartrate. Even this was far from satisfactory as the treatment had often to be unduly prolonged without concomitant successful results.

With a grant from the Indian Research Fund Association, Brahmachari got together a young band of organic chemists from the Calcutta

University and started work on the chemotherapy of Kala-azar with antimony compounds. From his clinical observations, he was decided in his mind as to the curative value of antimony in this infection but felt that the dosage administered was not enough. Unless the toxicity of the antimony salt could be reduced, an increase in effective dosage would not be possible. From an analogy of the value of the corresponding organic arsenic compound ('Arsacetin' and 'Atoxyl') in the treatment of certain protozoal diseases and from the more or less successful use of acetyl compound of antimony (Stibacetin, Stibenyl) in the treatment of kala-azar and other forms of leishmaniasis (by Caronia, Spagnoli, Von Heyden, etc.), Brahmachari concentrated his attention on 'Stibenyl' and similar aromatic antimonials. Mason-Bahr had already reported good results with Stibenyl but Mackie and others reported unsatisfactory results. It is not exactly known how Brahmachari conceived the idea of combining stibenylic acid with urea, but it is possible that he might have been trying to get an antimony compound suitable for intramuscular administration and was guided by the fact that combination with urea of an irritant aromatic antimonial would reduce local pain and discomfort, in the same manner as Quinine and Urea injections. In any event, as a result of this combination, Urea stibamine was produced, which even during early trials (1920-22), showed clear promise as a very potent remedy in the treatment of kala-azar. The chemical composition of Urea Stibamine is still undecided. It was originally reported to be a substance composed of urea and *para*-aminophenylstibonic acid with the empirical formula $C_7H_{10}O_4N_3Sb$. The "effective active principle" in this compound was claimed by some to be a di-substituted urea, *S*-diphenyl-carbamide-4:4 distibonic acid. Whatever be its chemical entity, laboratory and clinical trials all over Assam and other endemic areas indicated in no uncertain terms the remarkable efficacy of the drug—an efficacy corroborated by many workers, chief amongst whom may be mentioned Shrott and Christophers.

Brahmachari's name is so intimately identified with the discovery of Urea Stibamine that his other contributions as a clinician and as a chemotherapeutist are largely eclipsed and apt to be forgotten. As a diagnostician, he was held in high esteem by his contemporaries and he was the first to describe a new form of Cutaneous Leishmaniasis which is still listed as *'Dermal Leishmaniasis'* (Brahmachari) in all treatises on tropical medicine. In the domain of antimalarial chemotherapy, he left significant contributions through his studies of the quinoline and acidic compounds.

Fame, fortune and honour came to Dr. Brahmachari from every quarter—from his *Alma Mater*, the Calcutta University, from the Government, under whom he served and from almost all the scientific and academic bodies functioning in India. He was the recipient of the Griffith Memorial Prize, the Coates Medal, the Minto Medal, the Sir William Jones Medal and the Berkley Medal for his research contributions. He was elected President of the Medical and Veterinary Section of the Indian Science Congress in 1930 and General President at the Baroda Session of the Congress in 1936. In the Jubilee Session of the Indian Science Congress, when distinguished foreign delegates visited India, he again shouldered the responsibility of the Presidentship of the Medical Section. He was a President of the Royal Asiatic Society of Bengal and a Foundation Fellow of the National Institute of Science of India. He was one of the seniormost Fellows of the Calcutta University and was intimately connected with all its activities. Space will not permit a mention of the many other organisations with which he was associated. He was easily one of the most outstanding and towering personalities in the Indian scientific world and he fittingly played his part wherever he moved. He was first made a Rai Bahadur and was later Knighted in 1936.

Dr. Brahmachari was the author of several books and also contributed liberally to the scientific journals of his time both in India and abroad. His first book, *Kala-Azar—Its Treatment* (Butterworth & Co., Calcutta), came out in 1917. This went through several editions. In Carl Mense's *Handbuch der Tropenkrankheiten*, Vol. IV, he contributed a masterly chapter on Kala-azar in 1926. Subsequently, he published a fuller account in 1928 in *Treatise on Kala-Azar* (John Bale Sons & Danielson, Ltd., London). His *Gleanings from My Researches* in two volumes appeared in 1940 and forms stimulating reading to all workers in the field of chemotherapy. His active mind would not permit him to rest on the laurels already achieved. He was contemplating writing another book when failing health preparatory to his death prevented him from the effort.

The lifework of Brahmachari as one of the pioneers of chemotherapeutic research in India and probably also in the East will long remain a brilliant inspiration to all of those who are privileged to carry on endeavours in his field of choice; we owe more to him than to anybody else for putting medical research in India on the map of the world.

B. MUKERJI.

LETTERS TO THE EDITOR

ON A CURIOUS SOLUTION OF RELATIVISTIC FIELD EQUATIONS

IN the course of a recent investigation we have come across a metric which is Riemannian (non-flat) by virtue of the condition,

$$B_{\epsilon\mu\nu\sigma} \neq 0,$$

which satisfies the field equations of gravitation for empty space, *viz.*,

$$G_{\mu\nu} = 0.$$

which is free from similarities and for which the pseudo-tensor density of gravitational energy and momentum is *everywhere* zero, that is,

$$t_\mu^\nu = 0.$$

The metric is

$$ds^2 = -dx^2(1+kt)^p - dy^2(1+kt)^q - dz^2(1+kt)^r + dt^2,$$

where k is an arbitrary constant and p, q, r are constants subject to

$$p+q+r = 2, pq+qr+rp = 0.$$

It follows that if p, q, r are real they must lie between 2 and $-{}^2/_3$. If $q = r = 0$, the space-time becomes flat. One particular case of interest is $p = -{}^2/_3$, $q = r = {}^4/_3$. It is not correct to say that the metric gives a flat space-time when $t = 0$ because the surviving components of the curvature tensor, B_{4114}, B_{4224}, etc., are non-zero even when $t = 0$.

Either as a cosmological model, or as a transitional model for a finite portion of space, that is something like a vacuum pocket into which matter is rushing from the surrounding portions of an extra-galactic nebula, the asymmetric field given by the above metric deserves consideration. We have investigated all possible line-elements for which $g_{\mu\nu} = 0$, $\mu \neq \nu$ and the conditions laid down in the beginning are satisfied. The most general solution is one in which the four surviving g's are certain functions of one and the same variable. But the above solution is the only one we have found worth reporting. In an investigation like this, while there is the danger of discovering a solution of no physical interest, after much mathematical ado, one cannot at the same time overlook the possibility of discovering new gravitational situations.

V. V. NARLIKAR.
K. R. KARMARKAR.

Benares Hindu University,
February 8, 1946.

BANDS IN THE COPPER ARC

WIDELY spaced double-headed bands between λ 6600 to λ 5800 and a large number of weak bands from λ 5350 to λ 5200 are well known to occur in the ordinary copper arc in air and in flame spectra of copper salts. Although the electronic transition is not yet established, they are attributed to the CuO molecule and are observed intensely in a copper arc in an atmosphere of oxygen. In an investigation on these bands it has been observed that there is a group of three red-degraded bands (not recorded previously) appearing rather faintly in the ordinary copper arc in air, and considerably enhanced in the copper arc in high pressure oxygen. The electrodes used are of the Hilger

H.S. brand. The wavelengths of the bands are: 4488·14 (1), λ 4487·48 (3), λ 4487·04 (4) A.U. Experimental observations indicate that these bands are also due to the CuO molecule.

Andhra University,
Guntur, V. RAMAKRISHNA RAO.
February 16, 1946.

1. Loomis, F. W., and Watson, P. R., 1935, **48**, 280.
2. Pearse and Gaydon, *The Identification of Molecular Spectra*, p 109.

ULTRA-VIOLET BANDS OF MERCURY IODIDE

IN a previous letter[1] three new systems of bands between λ 2550-λ 2300 ascribed to the diatomic mercury iodide molecule have been reported. Photographs of the band spectra below λ 2300 have since been taken using ultra-violet sensitised and Special Ilford QIII plates. The G. & H systems[2] reported briefly by Prilheshejewa[3] have been obtained and measured under high dispersion. About forty band-heads are recorded in the G system, (λ 2250-2165). Analysis of the complex structure of this system has revealed the existence of three distinct V'' progressions. The G & H systems as well as the F_1, F_2, F_3 systems are found to have the same lower state, presumably $^2\Sigma$, as the C and D systems analysed previously.[2] A detailed discussion of the analysis of these bands will be presented elsewhere.

V. RAMAKRISHNA RAO.
K. R. RAO.

Andhra University,
Guntur,
March 11, 1946.

1. V. Ramakrishna Rao and K. R. Rao, *Curr. Sci.*, 1945, **14**, 319. 2. Rao, Sastry and Krishna Murty, *Ind. Jour. Phy.*, 1944, **18**, 323. 3. Prilheshejewa, *Phys. Z. Sowjet.*, 1932, **1**, 189.

PRINCIPLE OF CONSERVATION OF ENTROPY AND EQUATIONS FOR THE REVERSIBLE SATURATION ADIABATS

THE equations for the adiabatic ascent of saturated air in the atmosphere are derived by treating the ascending air and the resulting products of condensation—water (above 273° A) and ice below 273° A)—as a closed system and applying the well-known principle of conservation of entropy for the changes taking place in the system. Three distinct stages are usually considered during the ascent, *viz.*,

(*i*) *The Rain Stage* (T > 273° A) during which the product of condensation resulting from the ascent is water;
(*ii*) *The Hail Stage* (T = 273° A) during which all the liquid water is transformed into solid ice;
(*iii*) *The Snow Stage* (T < 273° A) during which the water vapour passes over directly into the solid state (sublimation).

It is obvious that if we write down the expressions for the entropy of the system in each of the three cases mentioned above, it should have the same value.

In his treatment of the problem in the second edition of his book on "Physical and Dynamical Meteorology", D. Brunt[1] starts with the principle of conservation of entropy, but the connection between his equation for the rain stage on the one hand and snow stage on the other is not quite clear. It might be mentioned that if we try to solve the equation for the snow-stage given by Brunt by substituting the entropy value used during the rain stage, it will lead to totally erroneous values despite the apparent similarity of the two equations.

This apparent contradiction can be got over if in developing the expressions for the entropy of the three phases of water we choose the temperature corresponding to the zero of the entropy scale *below* the freezing point of water in all cases and also postulate explicitly that below $T_0 = 273°$ A the liquid phase is absent. In this case the following expressions for the entropy can be easily developed:—

ϕ_1 = Entropy of 1 gram of dry air at temperature T and pressure $(p - e)$
$= c_p \log T - AR \log (p - e)$

ϕ_2 = Entropy of z grams of ice at temperature $T\ (< T_0) = z\, c_i \log T$

ϕ_3 = Entropy of y grams of water at temperature $T\ (> T_0)$

$$= y\, c_i \log T_0 + \frac{L_e\, y}{T_0} + y\, c \log \frac{T}{T_0}$$

$$= y\, (c_i - c) \log T_0 + yc \log T + \frac{L_e\, y}{T_0}$$

ϕ_4 = Entropy of x grams of vapour at temperature $T\ (\leqslant T_0)$ in equilibrium with ice

$$= x\, c_i \log T + \frac{L_i\, x}{T}$$

ϕ_5 = Entropy of x grams of vapour at temperature $T\ (\geqslant T_0)$ in equilibrium with water

$$= x\, (c_i - c) \log T_0 + xc \log T + \frac{L_e\, x}{T_0} + \frac{L_T\, x}{T}$$

(The symbols have the same meaning as in Brunt's book.)

If we consider the adiabatic ascent of a sample of saturated air in which 1 gram of dry air is mixed with grams of water vapour, we can derive the following equations:—

(*a*) *Rain Stage* $(T > T_0)$.

$$\xi = x + y$$

$$\phi = \phi_1 + \phi_3 + \phi_5 \tag{1}$$
$$= (c_p + \xi c) \log T - AR \log (p - e) + \frac{L_T\, x}{T} + \left[\xi\, (c_i - c) \log T_0 + \frac{L_e\, \xi}{T_0}\right]$$
$$= \text{Constant.}$$

Compared with the entropy equation given by Brunt we see that the expression within the double brackets (which is a constant for a given value of ξ) occurs as an additional term.

(*b*) *Hail Stage* $(T = T_0)$.

For the *beginning* of the hail stage, we have:—

$$\phi = \phi_1 + \phi_3 + \phi_5 \qquad (2)$$
$$= (c_p + \xi\, c_i) \log T_0$$
$$- A\,R \log (p_1 - e_0) + \frac{L_{T_0}\, x_1}{T_0} + \frac{L_e\, \xi}{T_0}$$
$$= \text{Constant.}$$

For the *end* of the hail stage, we have:—

$$\phi = \phi_1 + \phi_2 + \phi_4 \qquad (3)$$
$$= (c_p + \xi\, c_i) \log T_0$$
$$- A\,R \log (p_2 - e_0) + \frac{L_i\, x_2}{T_0}$$
$$= \text{Constant.}$$

Hence we have:—

$$- A\,R \log (p_1 - e_0) + \frac{L_{T_0}\, x_1}{T_0} + \frac{L_e\, \xi}{T_0} \qquad (4)$$
$$= - A\,R \log (p_2 - e_0) + \frac{L_i\, x_2}{T_0}$$

This is in agreement with Brunt's equation.

(c) *Snow Stage* ($T < T_0$)

$$\xi = x + z$$
$$\phi = \phi_1 + \phi_2 + \phi_4 \qquad (5)$$
$$= (c_p + \xi\, c_i) \log T$$
$$- A\,R \log (p - e) + \frac{L_i\, x}{T}$$
$$= \text{Constant.}$$

This equation is the same as that given by Brunt for the snow stage. In equations (1), (2), (3) and (5), the constant (ϕ) has the same value. It might be mentioned that the expression, $\xi\,(c_i - c) \log T_0 + \frac{L_e\, \xi}{T_0}$ represents the magnitude by which the value of the constant has to be altered when we come to the snow stage if we use Brunt's equation for the rain stage.

Meteorological Office, Upper Air Section, Poona 5,
February 16, 1946.

R. ANANTHAKRISHNAN.
S. YEGNANARAYANAN.

1. Brunt, D., *Physical and Dynamical Meteorology*, 1939, 59–60.

A TORNADO CLOUD AT MADRAS

A TORNADO cloud was observed towards the southeast of Madras on the 8th of October at 12-45 p.m. As there is no record of such a cloud having been observed before in this part of the country, a description of the meteorological conditions accompanying it and a sketch of the observed cloud were considered to be of sufficient interest to merit publication. It was unfortunate that a photograph of the cloud could not be taken for want of equipment at the time.

The phenomenon was seen from the Observatory at Meenambakkam which is on the southern outskirts of Madras. It seemed to be more than five miles away to the southeast of the Observatory and was probably over the sea. Earlier, the sky was about 7/10 covered with cumulo-nimbus clouds. A belt of sky, about 10 degrees above the horizon, was practically clear, except for distant whitish cumulus clouds. The base of the cumulo-nimbus clouds stood out in clear relief against this background. A funnel-shaped protrusion was observed in one place along this base line at 12-45 hours I.S.T.[1] It extended up to about 5 degrees above the horizon as in Fig. 1 and

FIG. 1. The tornado cloud at 12-45 p.m.

soon became bent near the lower end (12-50). The part below the bend decayed rapidly, while the part above gradually shrank into the shape of a turbulent cone (12-55). The whole protrusion vanished suddenly at 13-00 hours.

Graphs of the surface temperature and humidity on the 7th, 8th and 9th October as recorded by the self-recording instruments at the Observatory are reproduced in Figs. 2 and 3.

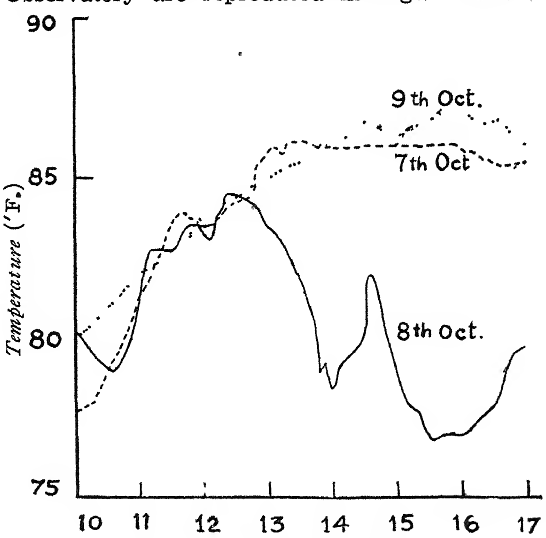


FIG. 2. *Time in Hrs.* I.S.T.

The temperature curve for the 8th shows a sudden fall from about 12-40 hours onwards, quite unlike what happened on the previous and following days. The relative humidity rose sharply on the 8th from about 12-30 hours in striking contrast with that on the other days. The upper winds at Madras, which were easterly even till the evening of the 7th, became northeasterly by 03-00 hours of the 8th and backed almost to the north by 09-00 hours. The winds continued to be northerly thereafter. The wind speed at all levels was, how-

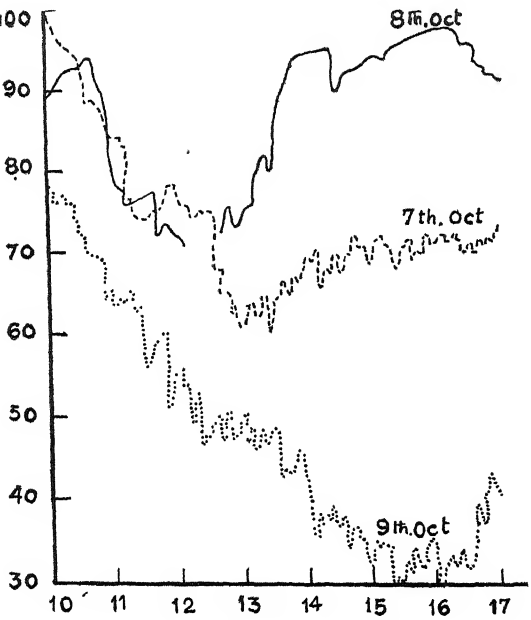


FIG. 3 *Time in Hrs.* I.S.T.

ever, low and did not exceed 15-20 m.p.h. on the 8th. The upper air temperatures, as determined by aeroplane ascents made at dawn, showed a fall by 2-4° F. at all levels on the 8th from the values on the previous day. There was no rain on the 7th and 9th, while on the 8th 34 cents of rain occurred at the Observatory during the period 13-40–15-30 hrs. The synoptic charts disclosed a general fall of minimum temperature up to about 300 miles to the northwest of Madras on the 7th, almost up to Madras on the 8th and practically over the whole of eastern half of the Peninsula on the 9th. There were no major disturbances in weather of any kind over land or out to sea.

It may be inferred, in view of the above facts, that the appearance of the tornado cloud was associated with the incursion of cold northerly air at Madras on the morning of the 8th, in the first flush of the northeast monsoon. The temperature contrast was probably small at the time and the tornado cloud may not have had enough supply of energy to reach down to the surface level. Even though the temperature fell later on to a fairly low value, the contrast seems to have been actually less marked, as there was not much of turbulence to be seen in the cloud.

One noteworthy feature of the tornado cloud was the pointing of its tapering end towards the south. This is what one should expect because of the spin of the earth.[1]

Meteorological Office,
St. Thomas Mount,
Madras, D. VENKATESWARA RAO.
November 20, 1945.

* The hours given in this article refer to the War Time.

1. Sir Gilbert Walker, "*Some Problems of Indian Meteorology*," *Hally Lecture*, May 1929.

A NEW METHOD OF GROWING *ASP. ORYZAE*

IN the course of our studies of the factors which influence the formation of enzymes, it became imperative to evolve a reproducible technique of culturing *Aspergillus oryzæ*. In addition to the nutrients and the growth factors, the fungus requires a moist 'bed' or 'soil' with a texture or 'tilth' for facilitating free and adequate access of air which is essential for the growth of the organism. In our earlier studies weighed amounts of acid digested asbestos fibre moisted with definite quantities of the nutrients were employed.[1] The large number of weighings thus involved, became laborious and it was not possible to secure uniformity of 'tilth' due to differences in the packing and spreading of the fibre in the reaction flask.

It was of interest to experiment with filter paper as a substitute for asbestos; it was expected to possess several obvious advantages; its readier absorption and retention of the nutrients; the case and rapidity with which given quantities of paper could be dispensed for experiments, and the facility and certainty of securing reasonable uniformity of 'tilth' and surface in the experiments. Test tubes (155 mm.× 15 mm.) slantingly placed as in the work on antibiotics in our laboratory,[2] served to replace the conical flasks employed in our previous studies; this innovation served to simplify and reduce the cost of the experiments.

EXPERIMENTAL

64 Square centimeters (80 mm.× 80 mm.) of Whatman's filter paper No. 1 were cut, folded and introduced into the test tubes. After plugging with cotton, the tubes were sterilised at 20 lbs. for an hour. The nutrient solution, together with supplements if any, is then introduced to moisten the filter paper which absorbs about 1·5 c.c. of the liquid; water is added to make up the volume to 3 c.c. in all the tubes and for allowing for evaporation during incubation. The fungus spore suspension is prepared and added to each tube. After incubation for four days at 23° C., the fungus mat along with filter paper is disintegrated, toluenated water (5 c.c.) added, autolysed at 37° C. for 24 hours, filtered. washed and the enzyme extract made up to 100 c.c.

The composition of the media is given below in Table I.

TABLE I

Composition of the nutrient media

Constituents	I	II	III	IV	V
*Bran extract (c.c.)	1·0	..	1·0	1·0	1·0
Starch (c.c.)	1·0	1·0	..	1·0	1·0
† Peptone (c.c.)	0·5	0·5	0·5	..	0·5
Salts (c.c.)	0·5	0·5	0·5	0·5	..
Water (c.c.)	..	1·0	1·0	0·5	0·5
Total volume	3·0	3·0	3·0	3·0	3·0

*Papain digest of wheat-bran 2 mg. /c.c.

†Difco Bacto-peptone 1·567 mg. N/c.c.

The diastatic activity of the extracts is determined as described previously.[3] The results are given below:—

TABLE II

Total Activity of the Enzyme Extracts in Linter Units

I (Full)	II (–bran)	III (–starch)	IV (–peptone)	V (–salts)
197·1	63·90	77·98	136·5	111·7
205·5	79·98	86·22	138·8	106·3

The results indicate that the method gives reasonably consistent and reproducible results.

M. R. RAGHAVENDRA RAO.
M. SREENIVASAYA.
Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
March 9, 1946.

1. Bindal, A. N., and Sreenivasaya, M., *J.S.I.R.*, 1945, **3**, 386. 2. Rammohan, R. Ramachandra Rao, T. N. and Sreenivasaya, M., *Ibid.*, 1945, **4**, 375. 3. Bindal, A. N., and Sreenvasaya, M., *Ibid.*, 1944, **2**, 245.

COAGULATION STUDIES OF CRYPTOSTEGIA LATEX

THE properties of the latex changed according to the seasonal changes and hence wide variations were observed in the percentages of dry rubber, non-rubber constituents and pH values. The latex was found to be stable between a pH range of 3·5 to 7·5. Beyond this range it exhibited curdling effect. Investigations of the coagulating properties of various chemicals were carried out in the Experimental Station at Okhla since 1943. Acids and alkalies could not produce coagulation. Common salt in sufficient concentrations as to saturate the serum of the latex effected coagulation. It was found that small quantities of common salt, formalin, or tannic acid, if mixed with the latex and heated to 85° C. for ten minutes could coagulate the latex. It has been reported that hot water between 30 and 90° C., if added in volumes about 7 times the volume of the latex, could produce efficient coagulation and the quality of the rubber produced by this method to be good. Though the method looks simple, in factory practice the procedure is inconvenient, as for example, if there is a crop of about 500 gallons of latex, 3,500 gallons of hot water at 80° C. is to be kept ready for coagulation.

It has now been found that soap is an excellent coagulant and can be used as soap solution of 0·5 per cent. strength, the pH being adjusted to 7·5 by the addition of any alkali. The volume of the coagulant required depends on the D.R.C. of the latex and in most cases it does not exceed 35 per cent. of the volume of the latex. It was found that 2½ lbs. of soap could coagulate about 100 lbs. of rubber. The samples of rubber prepared by the above process after compounding and vulcanizing were tested and found to be 85 to 90 per cent. as good as the best hevea rubber.

As certain colloidal dispersions are able to produce coagulation, investigations were continued to find out the effect of mixing Cryptostegia latex with hevea latex. A 100 c.c. of fresh Cryptostegia latex of D. R. C. 7 per cent. was kept in a beaker and ammonia preserved 30 per cent. hevea latex of alkalinity 0·6 per cent. was added in drops from a burette. After the addition of 7 c.c., it was found that there was complete coagulation of the rubber of Cryptostegia and hevea latices. The serum was brownish in colour and was absolutely free from rubber. The pH was observed to be 7·5. It was found that the serum obtained from hevea latex after acid coagulation did not coagulate Cryptostegia latex even after adjustment of pH to 7·5, probably because the acid had already precipitated the proteins of the serum of hevea latex. Therefore, to confirm whether it was the colloidal proteins or the rubber molecule that was responsible for the mutual coagulation, the serum of hevea latex obtained after driving off the ammonia and subsequent coagulation by bacterial activity, was added to 100 c.c. of Cryptostegia latex of the same D.R.C. It was found that 5 c.c. of serum was sufficient to produce effective coagulation of the Cryptostegia latex, if the pH was adjusted to 7·5 by the addition of a drop or two of ammonia solution. The serum extracted from frozen latex also behaved in the same way. The above experiments were then repeated with Cryptostegia latex cream, and it was observed that the quantities of ammonia preserved hevea latex and also of the serum obtained by bacterial activity required for coagulating the cream were smaller than those required for the normal Cryptostegia latex, for in the process of creaming a large percentage of colloidal proteins had been eliminated. This definitely proves that the coagulation of latices is brought about by the mutual coagulating property of their protective colloids, mostly proteins, and it supports Vernet's view that coagulation is caused by protein precipitation. By this method, the volume of the coagulant required is also reduced from 35 per cent. soap solution to 7 per cent. of hevea latex. Since there is complete precipitation, the percenage of non-rubber constituents are also reduced. The coagulum formed is found to be harder than when Cryptostegia alone is coagulated and hence it is easier to pass through the rollers to be converted into sheets. The discovery of the mutual coagulating property of the latices is of great technical importance in so far as a harder coagulum is obtained and also the introduction of chemicals are avoided.

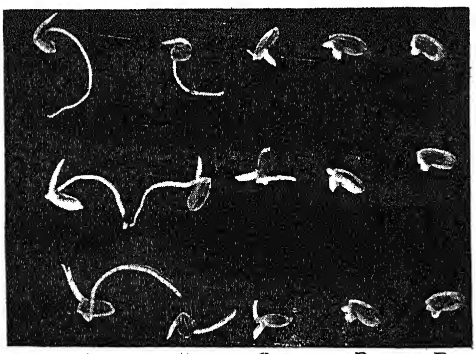
I express my thanks to Mr. J. P. Anderson, Controller of Rubber, for the facilities given to me to continue the researches and also for th permission to publish these results.

A. K. M. PILLAI.
Cryptostegia Experimental Station,
Government of India,
Muttra,
October 9, 1945.

THE EFFECT OF COLCHICINE ON RICE

Colchicine is a deadly poisonous drug prepared from parts of *Colchicum autumnale* (N.O. Liliaceæ) and is being extensively used in inducing gross genetic changes including polyploidy in various plants by many investigators. The present note deals with the result of the experiment carried by us to find out the effect of colchicine treatment on the growth and development of rice plant and also to observe whether any or all of the changed characters are transmitted to the subsequent generations Dhairal aus paddy, an improved strain of the will be published elsewhere, but a few important results are given below for ready reference.

Treatment of rice seeds and seedlings of Dhairal aus paddy, an improved strain of the Bengal Agricultural Department, and their progenies in subsequent years by colchicine, shows marked response. The treated seeds show on germination swollen appearance with shortened and thickened plumule, while the growth of the radicle is appreciably slowed down with increased concentration of the colchicine solution (Fig. 1). This swollenness decreases increas-



A B C D E

FIG. 1. Effect of varying doses of colchicine on rice seeds for 48 hours, showing the gradual swollen appearance of the plumule with increased concentrations of colchicine solution; while the growth of the radicle is gradually slowed down.
A-Control; B—.05%; C—.1%; D—.5%; E—.1·0%

ingly with the decrease of colchicine concentration and also with the decrease in the period of treatment. In the case of seedling treatment both plumule and radicle swell markedly. In higher concentration of the colchicine solution the survival of the seedlings is meagre.

A definite critical period for tillering from the 5th to the 7th week after sowing has been observed in treated and untreated progenies in 1944, while in control the tiller number goes on increasing. Treated progenies are the descendants of the 50 per cent. of seeds collected from the selected plants arisen from colchicine treated seeds. They are again treated in succeeding generations with the same doses of colchicine solution; while the untreated progenies are the descendants of the other 50 per cent. of seeds, without further treatment with the colchicine solution in succeeding generations. In 1942 and in 1943 no such critical period for tillering was observed. Generally in aus paddy there is no definite critical period of tillering. With the maturation of the early tillers, other tillers (late tillers) crop out from the base of the plants. In our experiment a cumulative effect has been obtained by colchicine treatment as evidenced by a distinct critical period of tillering already mentioned. Engledow (1923, 1924 and 1926) in his wheat experiment stresses the importance of early tiller formation as an index of high-yielding capacity in a variety.

In 1943 a clean tetraploid plant was also obtained in LP_1L_1 but the plant failed to set grains. In 1944 in EP_1EP_1E diploid and tetraploid chimeras having longer ears and bigger grains, were obtained (Figs. 2 and 3). It

FIG. 2. Ears of rice from control plant (*left*) and from tetraploid chimera (*right*). Note longer size of ears and of flag leaf in latter.

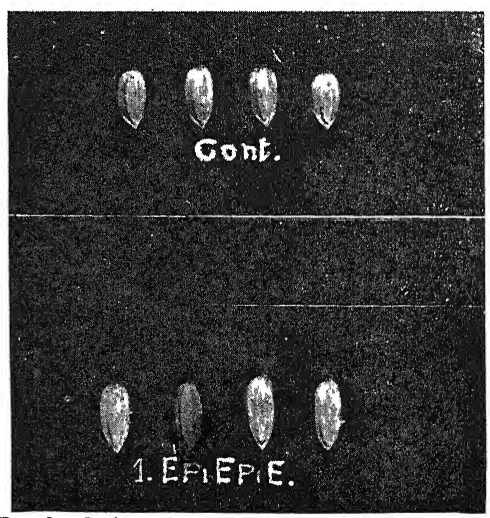


FIG. 3. Grains of rice from the control plant and from the tetraploid chimera. Note bigger grains in latter.

may be expected that in the next generation a clean tetraploid may arise from the grains collected from the tetraploid chimeras. Blakeslee (1939) observed in *Datura stramonium*, grown from a seed treated with colchicine both $2n$

and $4n$ branches. This is possible when seeds are soaked in colchicine solutions for varying lengths of time different cells in the epicotyl may be affected differently. Consequently the plant that develops may be a chimera of one sort or another (Bergner *et al.*, 1940).

The size of stomata has been measured from the control as well as from the treated and untreated progenies. No increase in size of stomata has been observed. They are more or less of the same size as that of control; while the larger size of pollen grains has been observed in treated progenies. Blakslee (1939) states that the larger size of stomata is characteristic of tetraploids but holds strictly only for comparable leaves. Stomata size was found a reliable criterion when the stomata were taken from the floral bracts of females.

Awn develops on one or two apical spikelets on the panicle of the tetraploid tillers in EP_1EP_1E; the other spikelets remaining awnless. Of course, the awned spikelets are sterile. Sethi *et al.* (1937) point out that crowding of plants tends to increase awn development irrespective of nutrition, as when adequate nutrition was supplied by heavy manuring the relation between the crowding and awnedness remained unaltered. But, here the case is different. Dhairal is an awnless strain of aus paddy. The occurrence of awn on the spikelet of tetraploid tillers is due to the increased vigour of that particular tiller occasioned by the cumulative effect of colchicine solution. Copeland (1924) observes: "Awns seem at least sometimes to be associated with general vigour perhaps in that they were a character of the ancestral wild rice and the breeder who would get rid of them might conceivably do this through the elimination of vigour. It is hardly questionable that as a general average awned rices are heavier producer than awnless varieties." Hector (1934) states that vigour may sometimes be associated with awns, but there is no definite correlation between awns and yield. In fact, most of the high-yielding Bengal rices belong to the awnless group.

One sheathed ear is noticed in EP_1EP_1E while sheathed ear is completely absent in Dhairal. All the spikelets of the sheathed ear are sterile. This is due to the expansion of the leaf-sheath which enclose the ear.

Marked rise in grain yield has been observed in EP_1EP_1E and in LP_1L where the number of fertile grains is also appreciably increased together with the increased length of ears. The results are given in the accompanying table.

Treatment	Mean of 18 plants		
	Length of ears cm.	Dry weight of grain. gm.	Number of fertile grain.
Control	16·4	6·68	274·9
EP_1EP_1E	19·4	9·47	366·8
LP_1L	17·6	8·87	377·2

† LP_1L–F_2 progeny of L which is seedling treatment in ·5 per cent. of colchicine solution for 2 hours, it is again treated in succeeding generations with the same doses of colchicine solution.

‡ EP_1EP_1E–F_2 progeny of E which is seed treatment in 1 per cent. of colchicine solution for 48 hours, it is again treated in succeeding generations with the same doses of colchicine solution.

S. HEDAYETULLAH.
B. N. GHOSH.
Central Agricultural Res. Station,
Dacca, Bengal,
January 29, 1946.

1. Bergner, A. D, Avery, A. G. and Blakeslee, A. F *American Jour. Bot.*, 1940, **27,** 8. 2. Blakeslee, A. F, *Ibid.*, 1939, **26,** 3 3 Copeland, E. B., *Rice*, Macmillan & Co., London, 1924 4 Engledow, F. L., and Wadham, S. M, *Jour Agri. Sci. Cambridge* 1923, **13.** 5 —, *Ibid.*, 1924, **14.** 6. Engledow, F L., *Ibid*, 1926, **16.** 7. Hector, G. P., Shaagapani, S. L. and Roy, K. P., *Ind. Jour. Agri. Sci.* 1934, **4,** 1. 8. Sethi, R. L., Sethi, B. L., and Mehta, T. R. *Ibed.* 1937, **7,** 4.

THE CUCURBITACEOUS STEM

THERE appears to be some lack of clarity in respect of the internal structure of the axis of the *Cucurbitaceæ* which is a very common material employed for class-work as a type to demonstrate bicollateral vascular bundles. In almost all the genera, a hypodermal collenchyma band and a deeper-seated sclerenchyma band are a common feature. In *Cucurbita maxima*, Duch., whose stem was examined critically, there were seen these two bands as also two concentric rings of vascular bundles, about five in each ring (Fig. A). Those in the outer ring are somewhat smaller and placed opposite the engles of the stem. While there could be no doubt as to the cortical nature of the collenchyma, doubt seems to exist regarding the fibrous ring. The parenchyma that comes below the sclerenchymatous ring comes for no description. Solereder (1908) mentions that the sclerenchyma ring is developed in the cortex. In the supplement (Solederer, 1908) it is described as a pericycle. In the form investigated at present (Fig. B), the following tissues are seen:—Single layer of epidermis (Fig. B 1), about five layers of collenchyma (2), about two layers of parenchyma (3, 4), about six layers of sclerenchyma (5), and a broad zone of loosely arranged parenchyma cells (6). Of the two parenchyma layers formed between the collenchyma and sclerenchyma, the lower is regularly arranged and is full of starch grains. Casparian bands are also seen. So it is the endodermis demarcating the inner limit of the cortex which on this interpretation must be said to consist of an outer collenchymatous portion five cells thick and an inner parenchymatous zone, one layer in extent. Obviously, the sclerenchymatous band that is internal to the endodermis must belong to the pericycle, and this has been indicated by some authors (Solereder, 1908; Strassburgher, 1924). If that is so, what is the nature of the broad stretch of parenchyma which intervenes the vascular

cylinder and the sclerenchymatous pericycle? It cannot be the cortex as it is internal to the pericycle which is the outer limit of the vascular cylinder. The suggestion is made that

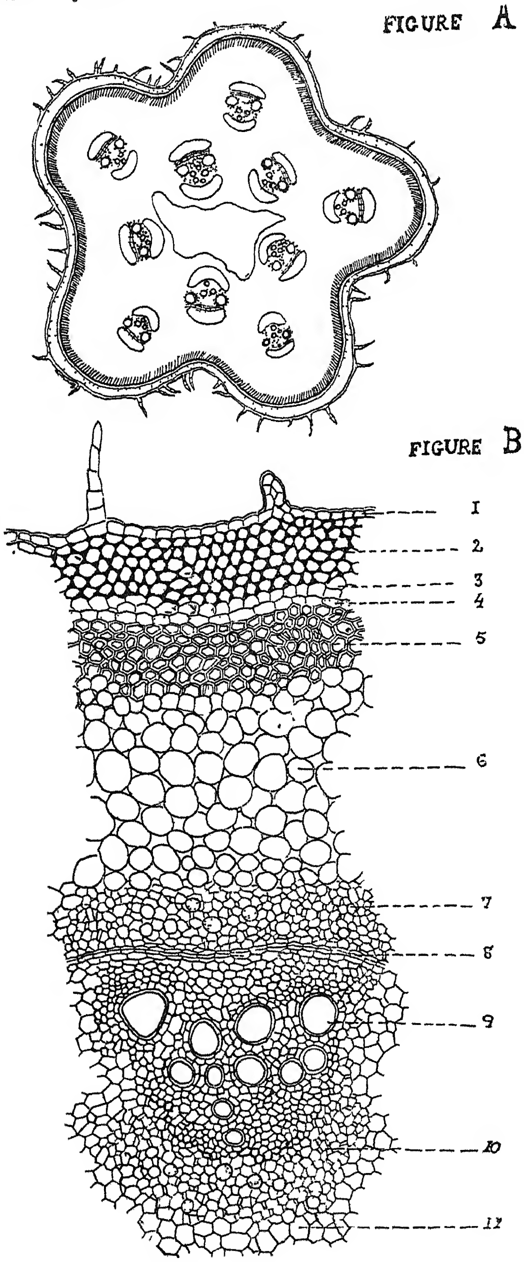


FIG. 1. Cucurbitaceous stem

the pericycle in the Cucurbitaceæ is differentiated into two regions, the outer sclerenchymatous and the inner parenchymatous. Heterogeneous pericycles are by no means rare. In herbaceous stems like *Helianthus* we find the pericycle made up of alternate bands of sclerenchyma (Hard-bast) and parenchyma forming a continuous multicellular pericycle ring. In this case, also, it is heterogeneous being made up of sclerenchyma and parenchyma, only instead of being juxtaposed, they are superimposed.

The Cucurbitaceæ have been of phylogenetic interest from the anatomical point of view. Worsdell (1915) came to the conclusion that the vascular system of the family represented a vestige of a former ancestral scattered system of vascular bundles, such as obtains in Monocotyledons. According to him only two series of rings remain in perfect condition, the rest appearing in the form of rudimentary external phlœm strands, etc. The bi-collateral bundle is, on this basis, a compound structure consisting of the intimate association of two distinct vascular bundles of which the inner has lost its xylem. According to him, therefore, this double ring of vascular bundles is a reduction from a scattered condition. Outside the zone of the two main bundle-rings, but within the sclerotic ring, a few extremely rudimentary phlœm strands were found in some genera. These, according to him, are vestigial. No such vestigial strands were, however, seen in the present material. If this position is accepted, the stretch of parenchyma from the sclerotic ring to the vascular cylinder should be regarded as the ground tissue. In some Monocots, like *Cynodon*, there is a sclerenchymatous ring of pericycle closely attached to which is a ring of small bundles. Internal to this, we find bundles of varying sizes scattered throughout the ground tissue. If Worsdell's view is accepted it implies that where originally bundles were closely approximating to the sclerotic pericycle, there we get ordinary parenchyma devoid of vascular strands. It means that the parenchyma tissue found internal to the sclerenchymatous pericycle must be in the nature of ground tissue. Whatever its nature may be, its presence must be noticed and explained. Without going into the question of phylogeny, on the basis of the structure found in the present day *Cucurbitaceæ*, it seems reasonable to designate the parenchyma as the inner pericycle.

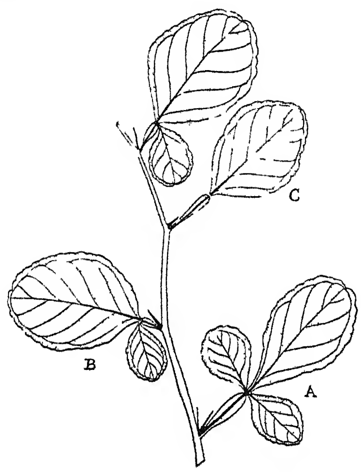
Botanical Laboratory,
Annamalai University, T. S. RAGHAVAN.
February 1, 1946.

1. Solereder, H., *Systematic Anatomy of the Dicotyledons*. Translated, 1908, by L. A. Boodle and F. E. Fritsch., **1**, 389-397. 2. —, *Supplement*., Pp. 936–939. 3. Strasburgher, E. *Hand Book of Practical Botany*. 1924, p. 126. 4. Worsdell, W. C. "The Origin and Meaning of Medullary (Intraxylary) Phloem in Stems of Dicotyledons, 1915, I Cucurbitaceae", *Annals of Botany*., **29**, 567-590.

A NOTE ON THE OCCURRENCE OF UNIFOLIATE LEAVES IN *TRIPHASIA*

Triphasia comes from the Greek Triplex (Bailey, 1933). It is a member of the *Rutaceæ*, tribe *Citræ*. According to Gamble (1919), it is found wild and cultivated, apparently introduced from China. It is even popularly called the Chinese Lime (Macmillan, 1935). But Hooker (1873) thinks it is a native of

Southern Concon. It is a mono-typic genus having a single species *Triphasia trifoliata* DC. (= *T. aurantiola* Lour.). Leaves are described as alternate, sessile and trifoliate, the lateral leaflets being smaller than the terminal. While on a botanical tour to the Palni Hills, on the scrub jungly base of the hills, this plant was very commonly met with. The tap-root is very deep and the plant is about 4 to 5 feet in height. An examination of a number of plants revealed that the majority of the leaves of the plants, had unifoliate rather than trifoliate leaves. All stages from the trifoliate to the unifoliate condition were seen in every plant as a rule. No specific region of the plant could be said to show this transition exclusively. It was found all over the plant. The accompanying figure shows a small portion of a plant in



Triphasia trifoliata, DC

which the leaf *A* shows the trifoliate condition, with the terminal leaflet much bigger than the two lateral leaflets. Leaf *B* shows the bifoliate stage.. Leaf *C* shows the Unifoliate condition. The rachis is slightly winged and the joint at its tip is very pronounced. The presence of the joint is the only test by which the leaf is determined to be a compound one with a single leaflet even as in the case of the staminate flowers of a *Cyathium*, where the articulate stamen is the criterion upon which it is considered as an appendage to the pedicel of a naked, one-stamenned flower. It may be that this is an another species of *Triphasia* because in *T. trifoliata* the leaves are definitely described as trifoliate. Also the thorns in the species under description are not so prominent as the description for *T. trifoliata* would have it. A more complete examination of the flowers and fruits of which enough could not be got now, would reveal whether or not it is the same species. This will be done as soon as flowers and fruits become available. In the meantime this plant appears to be very suitable for the visual demonstration of the evolution of the unifoliate condition from the trifoliate stage.

We are grateful to Prof. T. S. Raghavan for having brought this to our notice and suggesting relevant literature.

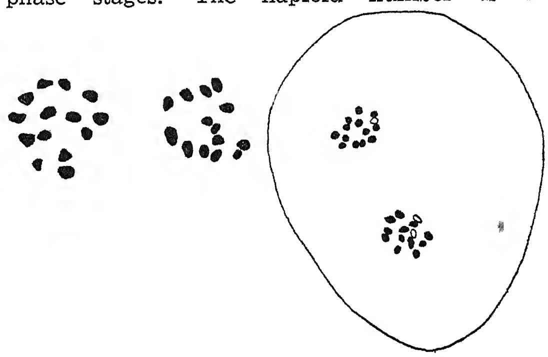
K. RANGASWAMI.
R RANGANADHAN.

Botanical Laboratory,
Annamalai University,
February 1, 1946.

1. Bailey, L.H., *Standard Cyclopedia of Horticulture*, 1933, **3**, 3383. 2. Gamble, J. S., *Flora of the Presidency of Madras*, 1915, **1**, 156. 3. Hooker, J. D., *The Flora of British India*, 1873, **1**, 507. 4. Macmillan, H. F., *Tropical Planting and Gardening*, 1935, p. 266.

CHROMOSOME NUMBER IN *CASSIA SOPHERA* LINN.

FOR sometime the writer has been studying the cytology of some species of *Cassia*. Among others *C. sophera* has also been investigated. The haploid chromosome number in this species was determined from temporary acetocarmine as well as permanent smear preparations of pollen mother-cells at I and II metaphase stages. The haploid number is 14



FIGS. 1–3.—*Cassia Sophera*. FIGS. 1 and 2—I. Metaphase. FIG. 3. II Metaphase. × 1200.

(Figs. 1-3). Previously Kawakami,[1] reported the chromosome number in this species which, according to him, is $n = 12$. His count seems to be incorrect. Hence the present report.

The basic number for the genus *Cassia* seems to be 7. Such a conclusion is based on the cytological investigations of some species of *Cassia* by the writer as well as on the previous reports of chromosome numbers in various speceis of *Cassia* by others (Senn,[2] Jacob,[3] Pantulu,[4] etc.). Where aneuploidy does not occur, the chromosome number can be expected to be $n = 7$ or simple multiples of the same. In a few cases, where a different number was reported previously these reports were proved to be incorrect by subsequent workers.[2,3 4]

Department of Natural Science,
Andhra Christian College,
Guntur (S. India), J. V. PANTULU.
January 2, 1946.

1. Kawakami, J., *Bot. Mag. Tokyo*, 1930, **44**, 319. 2. Senn, H. A., *Bibliog. Genet.*, 1938, **12**, 175. 3. Jacob, K. T., *Ann. Bot.*, *N. S.*, 1940, **4**, 201. 4. Pantulu, J. V., *Curr. Sci.*, 1940, **9**, 416.

CHROMOSOME NUMBERS IN *SESBANIA*

THE chromosome number in the genus *Sebania* Pers. was first reported by Kawakami (1930). Working with *S. aculeata*, he reported 16 *n* chromosomes. Subsequently, Krishnaswamy and Rangaswamy Ayyangar (1935) found $n = 7$ in *S. grandiflora*. Senn (1938) reported 12 somatic chromosomes in *S. tetraptera*. Recently Jacob (1940), after cytological survey of the genus, showed that *S. speciosa* and *S. Sesban* are secondarily balanced tetraploids with a basic number 4. He reported lateral satellites in *S. grandiflora* and the relationship between the size of the satellite and of the nucleolus in *S. bispinosa*.

The genus appears to be interesting from the point of view of its variable and unrelated chromosome numbers. A study of the chromosome numbers in *S. grandiflora*, *S. ægyptiaca* and *S. aculeata* shows that some of the previous reports are incorrect. This can be inferred from the following table:—

Species	*2n*	*n*	*Author*
S. grandiflora Pers.	..	12	This paper.
	..	7	Krishnaswamy & Rangaswamy Ayyangar (1935)
S. aculeata Poir.	..	6	This paper
	..	16	Kawakami (1930)
S. ægyptiaca Pers.	12	6	This paper

If the previous reports are correct, they indicate polyploidy within species. It is not improbable, as remarked by Senn (1938), that some of the previously reported species belong to different genera. Cytological details of the above three species will be published elsewhere.

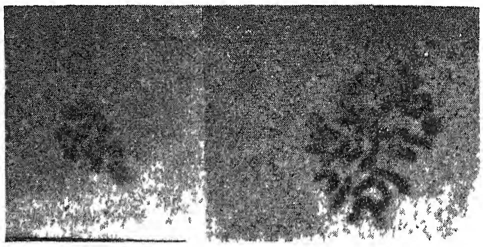
Department of Botany,
Mrs. A. V. N. College,
Vizagapatam,
February 27, 1946.
Y. SUNDAR RAO.

1. Jacob, K. T., *Ann. Bot.*, *N.S.*, 1940, **4**, 201–26.
2. Kawakami, J., *Bot. Mag. Tokyo*, 1930, **44**, 319–28.
3. Krishnaswamy, N., & Rangaswamy Ayyangar, G. N. *Curr. Sci.*, 1935, **3**, 488.
4. Senn, H. K., *Bibl. Genet.*, 1938, **12**, 176–337.

CHROMOSOME NUMBERS IN SESBANIA SPP.

KRISHNASWAMI and G. N. Rangaswami Ayyangar[1] have previously reported that in *Sesbania grandiflora* (Pers.) the chromosome number is $2n = 14$ and $n = 7$. They also quote Kawakami's[2] observation on *Sesbania aculeata* (Pers.) who finds in this species $2n = 32$ and $n = 16$.

The common Sesbania species, *S. grandiflora* (Pers.), *S. aculeata* (Pers.) and *S. ægyptiaca* (Pers.), were studied for chromosome number and behaviour, and the findings are as follows. In *S. grandiflora* as well as in *S. aculeata* $2n = 24$ and $n = 12$ while in *S. ægyptiaca* $2n = 12$ and $n = 6$. As the photomicrographs



Division metaphase P.M.C. *S. grandiflora* — Mitotic metaphase *S. aculeata*

show the chromosomes are well defined, large, and easy to count, and there are definitely more than seven bivalents in the pollen mother-cells of *S. grandiflora*, and less than 32 chromosomes in the cells in the root tip of *S. aculeata*. Large number of observations were made on meiotic and mitotic cells, and the material was obtained from plants grown locally. The numbers were constant in a species, and are consistent for the genus.

The present observation does not agree with those of previous workers. Probably the genus is quite variable as regards chromosome numbers. This variability is unusual when compared with the numbers in other species of Leguminosæ, as given by Gaiser.[3]

I am indebted to Dr. V. K. Badami, Ph.D. (London), Principal of the College, and to Mr. S. Sampath, who supervised the work.

ASHRAFUL HAQUE.
College of Agricultural Research,
Benares Hindu University,
March 7, 1946.

1. Krishnaswami and Rangaswami Ayyangar, G. N., *Curr Sci.*, April 1935, **3**, 488. 2. Kawakami, J., *Bot. Mag Tokyo*, 1930, **44**, 319–28. 3. Gaiser, L. O., *Bibliographia Genetica*, 1930 and 1933, **6** and **10**.

DEVELOPMENT OF ENDOSPERM IN *LOBELIA NICOTIANAEFOLIA* HEYNE

THE gametogenesis, embryogeny and nature of endosperm haustoria in the mature seed of *Lobelia nicotianæfolia* Heyne have already been described by Kausik (1938). The present account deals with the mode of endosperm development in the same plant, certain details of which were not available earlier. After syngamy the primary endosperm nucleus divides by a transverse wall, producing the upper primary micropylar and the lower primary chalazal chamber. Next a vertical wall is formed in the primary micropylar chamber and slightly later a similar type of wall in the primary chalazal chamber too (Fig. 1). Subsequently these pairs of cells become divided transversely, first the upper pair and then the lower (Fig. 2); so the embryo-sac comes to be made up of eight cells, arranged in four tiers of two cells each. Of these, the two cells of the first tier develop into the micropylar

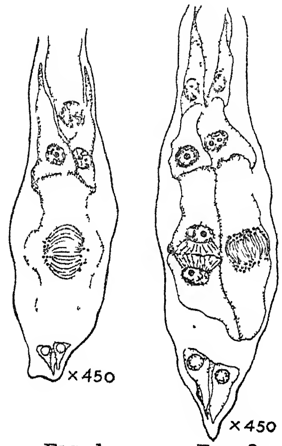


FIG. 1. FIG. 2.

haustorium, and the last pair of cells into the chalazal haustorium. The remaining two middle tiers form the endosperm tissue. The development thus follows the *Scutellaria*-type of Schnarf (1931). Endosperm development in *L. trialata* (Kausik and Subramanyam, 1945), however, differs in two minor respects from the one seen in *L. nicotianæfolia*; firstly, the vertical divisions in the primary micropylar and primary chalazal chambers are almost synchronous and secondly, at the four-celled stage of the endosperm the first transverse division takes place in the lower pair of cells earlier and subsequently in the upper pair. The *Scutellaria*-type of endosperm is also met with in the other species of the genus, namely, *L. amœna* (Hewitt, 1939), *L. trigona* (Maheshwari, 1944) and *L. trialata* (Kausik and Subramanyam, 1945).

Our sincere thanks are due to Mr. K. S. Gopalakrishnan for collecting the material and to Dr. L. N. Rao for kind encouragement.

S. B. KAUSIK.
K. SUBRAMANYAM.

Department of Botany,
Central College,
Bangalore,
January 31, 1946.

1. Hewitt, W. C., *Jour. Elisha Mitchel Sci. Soc.*, 1939, **55**, 63–82. 2. Kausik, S. B., *Jour. Ind. Bot. Soc.*, 1938, **17**, 161–8. 3. Kausik, S. B., and Subramanyam, K., *Jour. Ind. Bot. Soc.*, 1945, **24**, 175–181. 4. Maheshwari, P., *Curr. Sci.*, 1944, **13**, 186–17. 5. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, 1931, Berlin.

TRICHOGRAMMA EVANASCENS WESTW. (RACE *MINUTUM* RILEY), AN EGG PARASITE OF THE CASTOR SEMILOOPER MOTH *ACHAEA JANATA*, LINN.

DURING the course of the bionomics of the castor semilooper in 1943 in the Hyderabad State an egg parasite, *viz.*, *Trichogramma evanascens* Westw., was bred out of the eggs of *Achœa janata*. Some preliminary observations were made on this parasite and the results are summarised in this short letter.

Host.—The *Achœa janata* moths are nocturnal in habits. One to six eggs are laid on both the under and upper surfaces of the castor leaves. The eggs are laid singly. The egg is about 0·9 mm. in diameter. The eggs hatch out in 3-4 days. The caterpillars feed on leaves. The caterpillars when full grown either pupate on the leaf itself or in the soil. The total life-cycle lasts for about 28-47 days.

The parasite is pale yellow. Copulation starts soon after its emergence from the host egg and lasts for 2-3 seconds. Male is shorter than the female. The antenna in male is provided within numerous bristles. It is darker in colour. Soon after copulation the female goes round the host egg two or three times and after selecting a suitable spot, thursts its ovipositer and lays eggs. This operation lasts for 2-3 seconds. It has been observed that other wasps also lay eggs in the same host eggs. The parasitised eggs turn black within 48 hours. One to six eggs are laid in the host's egg by the parasite. The life-cycle lasts for five days.

The parasite breeds well in the eggs of *Corcyra cephalonica*. In the eggs of *Corcyra* the life-cycle of the parasite is completed in seven days.

The following table shows the incidence of *Trichogramma evanascens* in the *Achæ janata* eggs.

Date	No. of eggs collected	No. parasitised	Percentage of parasitization
28-6-1943	25	21	75
1-7-1943	30	27	90
19-7-1943	11	nil	nil
25-7-1943	27	12	44·4
28-7-1943	62	43	69·8
4-8-1943	32	21	65·8
8-8-1943	39	36	73
19-8-1943	22	22	100

Entomological Section,
Department of Agriculture,
Hyderabad (Dn.), M. QADARUDDIN KHAN.
January 28, 1946.

REFECTION PRODUCING BACTERIUM

REFECTION is a phenomenon discovered by Fridericia and his collaborators in Copenhagen. It relates to a condition that sometimes appears in experimental animals, mainly rats fed on vitamin B poor diet and characterized by normal growth in spite of this apparent deficiency. The excretion of such rats is usually white due to undigested starch. When potato starch is given the effect is still more pronounced than with rice starch, a fact which is difficult to explain. The important point about refection is that fæces contain vibrios which have not been cultivated so far but which are assumed to produce vitamin B. These vibrios were mostly found in the cæcum

of the rat. Through the kindness of Professor Scheunert in Leipzig I was able to procure such refected rats and I noticed that the hydrogen-ion concentration of such rats in the cæcal region corresponded to pH 6·6 while the normal rats in his laboratory had pH 6·8 in the same region. I had previously imagined that the intestinal fluids were rather alkaline to help tryptic digestion which, however, was not the case. Prune juice media with liver extract, maltose, yeast extract and peptone, without any meat extract, was used with pH 6·6 for cultivating these vibrios. The germs grew as impure cultures with *B. coli* and cultures were sent to Dr. M. Nathan who was working in Copenhagen under Prof. Fridericia about August 1938. These so-called vibrios grew like long chain of threads which were twined around an imaginary cylinder. There were also separate individuals. The growth of the colony was very thin and slow, that is, the sum-total of the individuals in a colony was very unlike a typical bacterium. The surface of such colonies resembled pictures of the germ of syphilis as grown by Prof. Reiter or like some delicate Mycobacterium. This habit explained very well how refection is a slow process, the germs by nature are not prolific so that the secretion of vitamin B takes place in minute doses which prolongs the period of recovery from vitamin B deficiency ending in refection. As the war is happily at an end it is appropriate to publish this small note. The work was done at the Institute of Hygiene, Leipzig, where I have to thank Prof. Dresel, its Director.

Laboratory of Biochemistry,
Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
February 21, 1946.

NEW SPECIES OF HYMENOPTEROUS EGG PARASITES OF *LEPTOCORISA VARICORNIS* F. AND *ASPONGOPUS JANUS* F.

N. C. PANT AND P. S. DUHAN, during the course of their investigations in 1944 on the bionomics of the pests, obtained hymenopterous egg parasites from the egg masses of *Leptocorisa varicornis* F. (Hemiptera, Coreidæ) and *Aspongopus janus* F. (Hemiptera, Pentatomidæ). These egg masses were collected from the fields at Cawnpore. The specimens were sent to the Director, Imperial Institute of Entomology, London, for identification. Through the courtesy of Dr. S. A. Neeve, the Director, Mr. Nixon, has kindly placed the specimens reared from *Leptocorisa varicornis* F. in the genus *Hadronotus* (Scelionidæ) and the other reared from *Aspongopus janus* F. in the genus *Eupelmis* (Eupelmidæ). I have since compared these specimens with the descriptions of other known species of hymenopterous egg parasites in these families and find that there are certain significant distinguishing characters to warrant them the status of new species. I have, therefore, named them as *Hadronotus varicorni* Pant., Sp. Nov., and *Eupelmis aspongopi* Duhan, Sp. Nov. Detailed descriptions of these parasites with full biological notes will be published in due course.

Zoology and Entomology Dept.,
Agricultural College,
Cawnpore, U. S. SHARGA.
February 12, 1946.

1. Mani, *Rec. Ind. Mus.*, 1936, **38**. 2. —, *Ind. Jour. Ento.*, 1939, **1**. 3. —, *Catalogue of Indian Insects*, 1941, **26**. 4. Pruthi and Mani, *Mem. Ind. Museum*, 1942, **13**. 5. Nixon, *Ann. Mag. Nat. His.*, 1938, 1938, **20**, 1, 2.

BRIEF NOTE ON SOMATIC VARIATION IN "KENTS" STRAIN OF *COFFEA ARABICA* L.

So far no case of mutation of somatic variation appears to have been described on "Kents" strain of *Coffea arabica* L. The present note describes briefly a sucker—a case of somatic variation on "Kents" plant observed at the Government Coffee Experiment Station, Balehonnur. The plant is a graft, nine years old, made up of Netraconda hybrid stock and "Kents" scion. The graft union is about six inches from the soil level. The mutant sucker has developed well above the graft union—3 feet above the union, and about 9-12 inches below the topmost pair of primary branches. It has grown up to 4 feet above the primary branches. The branches on the sucker make a very acute angle with the main stem of the sucker (Fig. 1). They are whippy

FIG. 1. A sucker—a case of somatic variation on "Kents" strain of *Coffea arabica* L., growing above the top-most pair of primary branches.

and are more vigorous in growth than the main stem of the sucker. Secondary system of branches is poor. The leaves on the sucker and its branches are very characteristic. The difference between the normal leaves on the 'Kents' plant (Fig. 2*a*) and those on the sucker (Fig. 2*b*) can be easily made out. The leaves on the sucker are broad at the base, thicker and coarser in texture, and crinkled in appearance. The veins make a very acute angle with the mid-rib and are curved. The flowers on the sucker appear to be normal except for the broader corolla lobes which give the flowers a

distinct appearance. A number of "Star flowers"—immature flower buds opening out

FIG. 2*a*. Normal leaves of the "Kents" plant.
FIG. 2*b*. Branches of the sucker showing leaves with broad base, coarser texture and crinkled appearance.

even when quite green—are noticed on the sucker. No fruits have developed on the sucker.

Krug (1938) mentions, " ... most of them (the variations) are gene mutations; the mutant branches are characterised by much smaller leaves and more intensified secondary branching, the internodes being generally much shorter ... A few cases of chromosome duplications were observed, a normal tetraploid plant producing octoploid Bullata branches; in two individuals vegetative reduction to half the chromosome number (Octoploid to Tetraploid) occurred. ..."

The morphological description given by Krug (1938) for the octoploid Bullata branches produced on a normal tetraploid plant appears to agree closely with the description of the variated sucker of the present note so far as the characters of the leaves and flowers are concerned. A full paper will be published elsewhere.

My thanks are due to Mr. K. H. Srinivasan, M.A., B.SC. (Edin.), Deputy Director of Agriculture, Bangalore, for his kind encouragement.

R. L. NARASIMHA SWAMY.
Govt. Coffee Experiment Station,
Balehonnur,
January 16, 1946.

1. Krug, C. A., *Variações Somáticas em Coffea Arábica* L, Instituto Agronomico Do Estado, Em Campinas Boletim Tecnico, 1938, **20**, 8–10.

A *RHIZOCTONIA* LEAF BLIGHT OF *DIOSCOREA*

Dioscorea alata L. (*Yam*) which grows wild throughout Assam is also cultivated to a limited extent in certain localities. Its tubers constitute an important article of food, and in times of famine it is of the greatest possible value. A severe leaf blight of this plant due to a species of *Rhizoctonia* was noticed for the first time at Sylhet in July 1944.

The first symptoms of the disease appeared on the lower leaves, which were in contact with the soil. Affected tissues were characterised by a clearly defined, water-soaked areas which progressed rapidly over the leaf. Within a short time the infected area collapsed and became flaccid turning from green to a dead brown. More or less concentric zones of light and dark brown colour were often observed, spreading from an infection centre. Following collapse of the leaf blade the infection spread down the petiole to the stem, where the other leaves and the stem became involved. Severe-blighted leaves often showed scattered strands of coarse mycelium traversing their surfaces. Fig. 1 shows the symptoms of the disease.

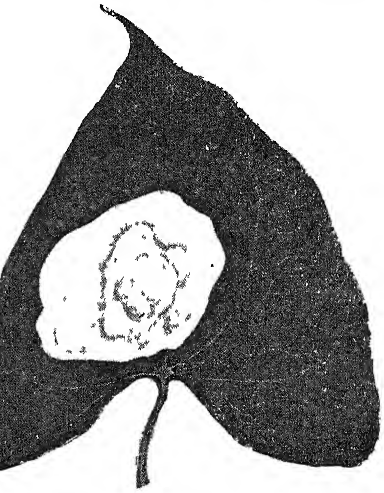


FIG. 1 × 1

A large number of isolations was made from the diseased tissues and a species of *Rhizoctonia* was always obtained in culture. All the isolates were identical. A large number of inoculation experiments was carried out and the pathogenicity of the fungus established. It was found that under damp humid conditions the parasite is rather virulent.

The morphological and physiological characters of the fungus were studied in culture and, by comparing it with a culture of *R. solani* Kühn, it was identified to be that fungus. Inoculation experiments carried out with the *Dioscorea* isolate on potato and with the potato isolate on *Dioscorea* further confirmed this identification.

The method of penetration of the fungus was studied. Leaves wounded and unwounded were inoculated at particular points by bits of the fungus hyphæ and kept in moist chambers. At 24 hours' intervals pieces of tissue cut out from around the place of inoculation were placed in a solution of equal parts of absolute alcohol and glacial acetic acid to remove the chlorophyll, then cleared in lactophenol to which acid fuchsin had been added.

The material fixed 24 hours' after inoculation showed no signs of penetration. After 48 hours' infection was macroscopically evident. Microscopic examination showed the mycelium traversing the surface of the leaves and small stromatic areas of knotted fungus strands distributed among the hyphæ. The stromatic areas or 'infection cushions' have been described by Duggar[1] as playing an important role in effecting penetration.

Initial penetration by the fungus takes place immediately beneath infection cushions and seems to be a mechanical process. The infection cushions appear to act as a fulcrum against which a force is exerted that is sufficient to allow hyphæ to penetrate uninjured epidermal cells. Infection cushions were formed on the lower as well as on the upper surface of all inoculated leaves regardless of the location of stomata. Wounded and unwounded leaves showed marked symptoms of infection within four to five days.

It is probable that in Nature the most highly pathogenic cultures of *R. solani* penetrate directly and are not dependent on wounds or stomata as avenues of entrance into their hosts. So far this fungus has not been reported on *Dioscorea*. This communication thus records the first report of its occurrence on *Dioscorea* leaves.

Plant Pathological Laboratory,
Sylhet, Assam, S. CHOWDHURY.
January 30, 1946.

1. Duggar, B. M., *Ann. Mo. bot. Gdn.*, 1915, **2**, 403-458.

WILT OF PINEAPPLE IN ASSAM

FOR the last few years a wilt disease of pineapple [*Ananas comosus* (L.) Merr.] has been observed to occur in certain pineapple-growing tracts of Assam and found to cause considerable damage. Outbreaks of the disease are usually spasmodic in their occurrence but when an outbreak does occur it may spread over a wide area with great rapidity. So far the disease has not been reported from any other part of India. Outside India it has been known to occur in Queensland only (Lewcock, 1935).

The disease is prevalent during the rains and causes the greatest damage during periods of excessive rainfall. Plants one to two years old are most subject to attack, which invariably results in cessation of growth, both of suckers and parent plant. In the initial stages of the disease the leaves of the affected plants lose their normal dark-green colour and assume a drab olivaceous hue. At first limp and flabby, they quickly droop and fall to the ground. This collapse of the foliage is the most striking symptom of the disease. After the plant has collapsed the leaves wither, commencing at the tips, but the final stages of the disease are slow and complete shrivelling of the foliage may be delayed for months.

When a plant becomes affected by the disease while its fruit is still immature, the subsequent development of the fruit is arrested and it colours prematurely. This premature colouring of the immature fruit on the wilt-affected plant is preceded by a pronounced withering of the fruit stalk for several inches immediately below the base of the fruit. Despite the drying out of the fruit stalk, however, its rigidity is usually such as to maintain the fruit in an upright position. Detachment of a fruit from a withered fruit-stalk is a matter of comparative difficulty, a twisting movement being required to dislodge it. Prematurely coloured fruits from wilt-affected plants are spongy in texture and sub-acid to the palate. Consequently, they have no commercial value even when of marketable size.

Rotting of the roots is invariably associated with the foliage symptoms of wilt, in fact decay of the roots may well be advanced before any foliage symptoms become apparent. Affected plants are usually so lacking in roots that they may be pulled from the ground with little effort.

A large number of isolations were made from diseased specimens collected from the different pine-growing tracts. A species of *Phytophthora* was always obtained in culture. The pathogenicity of the fungus was established in the usual manner by isolation, culture inoculation, re-isolation and comparison.

The morphological characters of the fungus were studied in culture, and the fungus was identified as a strain of *Phytophthora parasitica* Dastur. In Queensland, the cause of pineapple wilt has been ascribed to *P. cinnamoni* Rands (Lewcock, 1935).

Studies on the contributory factors and methods of control of wilt are in progress.

Plant Pathological Laboratory,
Slyhet, Assam, S. CHOWDHURY.
October 22, 1945.

1. Lewcock. H. K., *Qd. agric. J.*, 1935, **43**, 9-17.

HAIR BALL IN THE STOMACH OF A CALF

WHEN I came across Mr. D. Chakraborthy's letter on hair ball in the *Current Science* of February 1946, I thought that the following observations may be worth recording.

Experience in this laboratory shows that hair balls may frequently occur in the stomach of guinea-pigs. They have been found in experimental animals as well as in cases of spontaneous death. Sizes up to about two inches in diameter have been met with. They were black, fairly hard, spherical or oval in shape and difficult to break because of the fibrous structure. On breaking, they were found to consist of closely packed bundles of hairs held together by what apparently looked like the animal's excreta. Obviously, these balls take a long time to form and, as the animals are usually kept in groups, it was difficult to decide whether the hairs were from the same animal or from others. No attempt has been made to establish the source.

In no case was spontaneous death traceable to the effects of the ball. But it is difficult to imagine that such a big hard lump can exist in a relatively small stomach without producing any obstructive effects. In some cases, macroscopic abrasions of the mucous membrane of the stomach wall were visible on post-mortem examination.

Such balls have never been encountered in rabbits. Guinea-pigs in this laboratory are usually fed with sprouted Bengal gram and green leaf.

Bacteriology Laboratory,
Andhra Medical College,
Maharanipet,
Vizagapatam, N. G. PANDALAI.
March 4, 1946.

REVIEWS

The Chemistry of Cellulose. By Emil Heuser. (John Wiley and Sons Inc., New York; Chapman and Hall Ltd., London), 1944. Pp. 660. Price $7.50.

Emil Heuser belongs to the select group of cellulose chemists who, in addition to their significant contributions to our knowledge of cellulose, have also written authoritative books on this complex subject. His "Lehrbuch der Cellulose Chemie" has long been a standard text-book of the student. Here now is a much more comprehensive volume which can only be adequately described as a monograph.

In comparison with many other organic compounds in nature, cellulose is essentially simple in structure being but a polymer of glucose anhydride (although it took years of research work by a large number of workers to reveal this simplicity). At the same time, the unusual arrangement of these molecules to form the framework of the vegetable fibres, the high molecular weight and colloidal nature of the various forms of cellulose invest this substance with properties which are by no means well understood. Also, the use of cellulose as raw material in many important modern industries resulted in much work being done on these applied aspects of cellulose chemistry and in turn has posed many fresh problems to the research worker. For an appreciation of these large fields of work in their true perspective and to adequately summarise our present knowledge of the subject required talents of an unusual order. And these find full expression in the volume under review.

The general plan of the book is simple and comprehensive. To start with, the author recognises that "in dealing with the chemistry of cellulose we cannot afford to neglect either its microscopic or submicroscopic morphological structure or, as a result of its high polymeric character, its colloidal nature—these peculiarities call for close consideration because they cause the reactions of cellulose to take a more or less heterogeneous course ..." To this extent, the volume includes a critical study of what are usually termed the purely physical properties of cellulose, under two chapters—morphology of the fibre and composition of cell walls (Chapter II) and the molecular weight of cellulose (Chapter XV). The chapter on Morphology also has an account of the formation of cellulose in plants.

The chemical properties of cellulose are discussed in twelve chapters and include all the important reactions of cellulose in its behaviour as a polyhydric alcohol and as a polysaccharide. The latter comprise the large number of reactions involving the degradation of the cellulose molecule to shorter chains. Th association of water with cellulose—whose exact mechanism and the nature of the resultant complex is controversial—forms a separate chapter. The action of aqueous alkalies also rightly claims a chapter as befits the theoretical significance and practical importance of the reaction. The effect of organic bases, ammonia and salt solutions, are clubbed together. The very large amount of work on the solution of cellulose in cuprammonium hydroxide is summarised in a masterly fashion. Then follow critical reviews of cellulose esters, xanthates and ethers. The X and XI Chapters are devoted to the oxidation of cellulose and the decomposition of cellulose by acids. Lastly, the decomposition of cellulose by heat and by biological processes are themes which have received much too scant attention in the earlier treatises on the subject and greatly add to the usefulness of the present volume.

Two features of the book strongly impress the reader. The first is the wealth and comprehensiveness of the literature cited. Most of the more important papers on the subject right up to October 1943 have been garnered—a remarkable achievement under the prevailing war conditions for a volume published in 1944. The second feature is the objectivity with which the mass of data has been presented—by no means easy for an active worker in the field. Conflicting view-points are presented fairly and fully and there is no intrusion of the author's own appreciation of the probable truth. This detachment is so scrupulously maintained that in discussing the formation of cellulose in plants, he says, "It *seems* to be an established fact that the plant synthesizes carbohydrates from carbon dioxide and water by a photochemical reaction" (Italics ours). This cautious objectivity is characteristic of the monograph as a whole. And, while this assures the research worker a bird's-eye view of all the available data and leaves him free to draw his own conclusions—by reference to the original papers if necessary—this very virtue places the volume above and beyond the requirements of the average student.

The volume is provided with an author index and a subject index, both prepared with a thoroughness which is necessary. The printing and get-up of the book would do credit to the publishers even during normal times. Under war conditions, it is a feat in itself.

Emil Heuser's monograph is a notable contribution to the literature on cellulose in the English language. Cellulose chemists and technicians concerned with the industrial transformations of cellulose place themselves under a needless handicap by not possessing this volume.

Chromosome Atlas of Cultivated Plants. By C. D. Darlington and E. K. Janaki Ammal. (George Allen and Unwin Ltd., London), 1945. Pp. 397. Price 12*sh.* 6*d.*

The authors have made a new approach to the study of the distribution of cultivated plants of the world different from the approach

made by taxonomists, who have hitherto depended for classification on morphological differences. Darlington's views on the limitations of earlier methods of taxonomists have been clearly expressed in his contribution on "Taxonomic species and genetic systems". The species concepts of earlier systematists break down when applied to certain families of plants. The question, therefore, arises as to the limit that should be set by which to judge the standard of fixity of species. There is no agreement on this point amongst systematists themselves. What may be considered a homogeneous species by the systematists, may easily prove not to be so when analysed from the point of view of genetics and cytology. It is these latter aspects of enquiry which Darlington and Janaki Ammal have applied in their study of the distribution of the cultivated plants of the world and of the diversity exhibited by them.

The authors have confined their attention to the cultivated plants of the world necessarily, because experimental breeding and chromosome study have been largely confined to these plants which are easy to work upon. The accumulated results obtained from over a quarter-century of experimental work of breeding and chromosomal investigations have been assessed and certain conclusions have been drawn which have helped to rearrange the taxonomic species in a differnt manner so that the homogeniety or diversity within a species is more clearly brought out.

In the introduction to the book which has been contributed by Darlington, a clear picture is given of the process at work in the production of variation and the grand process of evolution. Reference is made to the work of Vavilov, who by a thorough study of the cultivated plants of the world and their genetic diversity, was able to trace the centres of origin of the staple crop plants. The Vavilonian idea of the centre of origin of a crop plant associated with its maximum diversity is shown not always good. Centres of diversity of many crops have shifted, the causes for shifting being either a shift in the centre of greatest cultivation, changes in civilization or changes in natural conditions. Species and varieties have been improved and changed to a considerable extent by cultivation. The part that agricultural operations such as tillage, sowing and harvesting have played and the replacing of the methods of inbreeding by outbreeding and *vice versa* on the evolution of the cultivated plants are briefly explained. In the latter part of the introduction the role played by chromosomes in the development of cultivated plants and in causing diversity are broadly dealt with. The effect of selection and mutation within different systems of mating, polyploidization and the several other ways of chromosomal changes which bring about divergences of various types are enumerated. It is pointed out that these newer methods of analysis will be combined with Vavilov's methods to unravel the past of the cultivated plants.

It is admitted that the new classification on which charting of the chromosome atlas is based is to be understood as diagrammatic as it is the first attempt and as part of the classification is based on conjectural evidence and has not been experimentally verified. The significance of chromosome numbers in gauging the inter-relationship of the species and in the results to be expected in species hybridization are pointed out. Within a morphological species, there may exist a polyploid series splitting it into what is called several "potential new species". Each member of a polyploid series is a genetic species isolated from another more strictly than are distinct morphological species with the same ploidy. It is pointed out that in the process of "evolution" "morphological groupings thus point backwards", that is, to the source of divergence and "chromosome groupings point forwards", that is, to the potentiality contained within a species to future development. The introduction concludes with the important statement, "For 30 years, cytologists and systematists have been discussing the bearing of chromosome change on classification in particular groups. Now from a summary of the total observation, we can get a bird's-eye-view of the whole process of the evolution of genetic systems in the flowering plants. It is only a bird's-eye-view, often indistinct and remote, yet already in sense, it shows the plan and the proportions of nature".

The chromosome atlas is a catalogue of cultivated plants based principally on the chromosome number. The arrangement of the families follow partly the older system of morphological classification, wherever it has been found desirable to retain such arrangements and in others the authors have followed a different method of grouping based on chromosome number. All these are fully explained in the portion on "Explanation of the catalogue". The catalogue gives the chromosome number of over 11,000 species belonging to 2,000 genera. Chromosome numbers of some of the species included in the catalogue remain to be determined. An extensive bibliography, a useful index and two maps, one each to show the cultivated and the wild plant regions of the world, are included. The importance of a book of this nature cannot be over-estimated. It will be of considerable help to geneticists, cytologists and to systematists who would now be able to assess the value of chromosomal changes on classification of plants into particular groups.

L. S. S. KUMAR.

Lubricating and Allied Oils. By Elliot A. Evans. (Chapman and Hall Ltd., London), 1945. Pp. x + 210. Price 15/-.

The publication of the third edition of *Lubricating and Allied Oils* is to be welcomed. Due to wartime conditions, the results of recent investigations all over the world could not have reached all quarters, and the volume, which includes some of the latest researches in the field is, therefore, a distinct contribution to the literature on oils.

The author has revised and enlarged his well-known book in this edition with a view

to bringing the subject up to date. In so doing, some discrepancies have crept in. Thus on para 2, the time of carvings on the Egyptian tomb of *Ra-Em-Ka* is given as 2600-1700 B.C., whereas in a paper by Francis J. Licate (*Ind. Eng. Chem. Ind. Ed.*, 1938, 30, 550), the date given is 2100-2600 B.C. Then it is known, and the author himself mentions it in para 4, that in the pre-petroleum days the only lubricants which were available were the common fatty oils. But from the first paragraph of Chapter III, one is led to believe that the use of petrol was known earlier than of vegetable oils. The molecular structure of fats and oils is not so fragmentary now as depicted by the author. Even the quantitative study of the component glycerides in natural fats has been pursued since 1927. Very valuable and useful work on the chemical constitution of fats has been done by Hilditch and his associates at Liverpool.

It would have been better if only those oils which are used in lubrication had been taken up for detailed discussion; the drying oils like *Oiticica* (not *citicia* as printed on page 17) and linseed oils could have been left out conveniently. A wrong statement has been made in the last paragraph on page 52 in mentioning the soluble and insoluble sludges from oils used in gears and turbines. As is evident from the Tables on pages 52 and 53, the sentence should read, "Consequently it is not surprising that the benzene soluble is sometimes considerably *more* than the benzene insoluble", instead of "... considerably *less*".

The value of the book would have been enhanced, had the author discussed at length the merits and significance of the various tests described in Chapter VIII, instead of the practical details. For the latter more authoritative works like *"Standard Methods for Testing Petroleum and its Products"* by the *Institution of Petroleum Technologists* and *"A.S.T.M. Standards on Petroleum Products and Lubricants"* could be referred to.

Though the author's book on *Additives* which is under preparation will be greatly welcome, and will satisfy an important requirement, the descriptions in Chapter IV could have been rendered more explicit if this important subject had received some attention. The modern petroleum industry depends to a great extent on the additives that are used in stabilising the various products. This rather young, but by no means unimportant, branch of petroleum technology finds use in oxidation and corrosion inhibition, improving oiliness, film strength, viscosity index and detergency, pour points depressing, etc.

The author refers to the mineral lubricating oils compounded with small quantities (up to 5-10 per cent.) of vegetable oils, but he has omitted to mention the important researches carried out in recent years on the utilization of vegetable oils either as such, or in admixture with mineral oils, in much larger amounts (as much as 50 per cent.) for lubricating purposes. Apart from the fact that vegetable oils have a high degree of oiliness, low coefficient of friction and high film rupture strength, the utility of these oils for lubricating purposes cannot be under-estimated on account of several other important reasons. The mineral oil resources of the world, though large, are not evenly distributed, and there are many countries which do not possess them all. It is also believed that the world's mineral oil reserves cannot indefinitely cope, with the ever-increasing demand for lubricating oil and that a shortage will make itself felt in course of time. Efforts are being made, therefore, to find out methods for substituting vegetable oils for mineral oil lubricants. Vegetable oils develop rancidity and acidity, especially in presence of metals like iron and copper. Various inhibitors have been found to stabilize these oils against oxidation and polymerisation so that they may serve as efficient lubricants. Much of this work has been described by Balada, Freund and Thamm, and has been carried out in India by Aggarwal, Chaudhuri, Mukerji and Verman (*Bulletins of Indian Industrial Research*, Nos. 18 and 20). The author's idea as given on page 66 that oxidation inhibitors for vegetable oils are not known appears to be ill-founded. The work carried out by Aggarwal, Bhatnagar, and Verman (*J. Sci. and Ind. Res.*, 1943, 1, 261), on vegetable-mineral oil blends leads to this conclusion. A contribution which has already found extensive use in railways has been made by Bhatnagar and Ward on the compounded blown rape-mineral oil for axle lubrication. The fatty materials have also been used as agents for carrying active elements such as chlorine, sulphur and phosphorus in the mineral lubricating oils.

The matter contained in the chapters on "Mechanical Testing" and "Oils Employed", will no doubt be helpful to the practical engineer in the selection of a lubricant best suited for his machine. Description of oils for cables, chains, metal cutting, quenching, tempering and thermostats, has also been included in the chapter, most probably due to the reason that they are mostly derived from mineral origin. A short account of the fluids used in hydraulic brake mechanisms would have been very much to the point in the book under review.

The employment of various types of engines, especially internal combustion engines, whether on land or sea or in air, has greatly increased and will increase still further with industrial expansion. New problelms on lubrication will arise with these developments. Any treatise, dealing with the recent aspects of this important subject will prove useful not only to practical engineers, chemists and physicists, but also to research workers engaged in this field. The book meets these requirements adequately and, therefore, deserves wide attention.

JOTI SARUP AGGARWAL.

Mr. Tompkins Explores the Atom. By. G. Gamow. (Cambridge University Press), 1945. Pp. ix + 97. Price 10*sh.* 6*d.*

This book is a sequel to the author's *Mr. Tompkins in Wonderland.* It is certainly as good and useful as the previous book.

The book commences with a dream of Mr. Tompkins on Maxwell's demon. Herein,

the mathematical ideas of probability are extremely well brought out. This is followed by a dream on the gay tribe of electrons. In this chapter, the modern ideas of the outer structure of the atom are very lucidly explained. In the next dream which is given the title, "The woodcarver", our present ideas about the elementary particles and the nucleus and the atom come up for very clear description.

The three dreams are followed by an appendix of four lectures by the professor which inspired the dreams. These four lectures give a most complete and precise description of the structure of the atom and the formation of compounds. They also contain details of nuclear fission.

This book has been published at a time when we talk of the dangers of the atom bomb and the harnessing of nuclear energy for human welfare. Nobody in the world can afford to remain ignorant of the basic principles of this branch of physics The book under review explains these principles clearly in a manner that an average man of some commonsense and intelligence can easily understand. As such, it is most welcome and should be read by everybody. Its real value can be gauged from the following fact. The reviewer received the book on the 2nd of January for reviewer. He finished it and kept it by the same night! But he could not see the book again for writing the review till the 9th of March. It wandered from hand to hand, from lady to lady, from doctor to doctor, from student to student, and so on. The reviewer only found a slip on his table: "Mr. — says he read Gamow's book and found it marvellous. I have taken it from him for a night Pardon my doing so", and so on. The reviewer talked to some of these readers and found that they *had* got a hang of our modern ideas!

The book is very well got up. There are a large number of illustrations and the printing is good. On the whole, the get-up is of the standard we have come to expect of the Cambridge University Press.

It is a popular book and it is extremely well written. It is written by one of the most well-known theoretical workers on nuclear physics It is published at a time which is most opportune. Every man, woman and child must read it—even professional scientists.

Prof. Gamow and the Cambridge University Press are to be congratulated for having brought out such a popular and such a useful book at such a very opportune time.

S. V. Chandrasekhar Aiya.

Physical Methods of Organic Chemistry, Vol. I. Edited by A. Weisberger. (Interscience Publishers Inc., New York), 1945. Pp. 736.

The theoretical development of organic chemistry that took place in the middle of the nineteenth century appeared to stagnate to some extent for nearly half a century. The contribution of a few physical chemists and mathematical physicists then gave a new impetus to organic chemists by giving a greater precision to the concept of atoms and molecules and the nature of the forces binding them. This led to new and improved methods of tackling organic compounds and their reactions. In his preface to the volume under review, the editor remarks, "The chemist, in order to acquaint himself with a certain physical method, has in the past been compelled to search through periodicals and specialised books. The present work has been compiled with the hope of relieving him of much of this burden". A perusal of the volume indicates that this claim is to some extent justified.

Till the beginning of World War II, scientific workers were more or less dependent on books in German for any thorough and comprehensive publication of an authoritative nature and during the past few years monographs in English have been coming from American publishers. One feature common to these is noticeable in the present publication: wherever possible one gets the name and address of the American Scientific Instrument Manufacturer from whom the instrument described is obtainable. This information is no doubt useful but one cannot help commenting on such indirect advertisements as an undesirable feature in a scientific publication.

The present volume contains sixteen chapters dealing with the following topics: Determination of melting and freezing temperatures; Determination of boiling and condensation temperatures; Density; Solubility; Viscosity; Surface and Interfacial tension; Properties of monolayers; Osmotic pressure; Diffusivity Calorimetry; Microscopy; Crystal form; Crystallochemical Analysis; X-Ray Diffraction; Electron Diffraction; and Refractometry. A fair amount of the experimental side is well described in the different chapters but the unevenness of a composite work by several authors is noticeable. A description of Beckmann's Freezing-point method in the opening chapter could have been completely omitted as the method can be found in the most elementary books on Physical Chemistry which an undergraduate handles. Though our knowledge of solvent-solute interactions is still inadequate, one cannot agree with the authors that the solvent for crystallisation must be decided by a trial and error process. The preparation of pure samples by crystallisation from melts does not seem to find a place in the chapter. The chapter on density determinations by Bauer is useful for its critical study and the valuable guide to the selection of method. The short chapter on Viscosity gives no new methods not available easily and is to be noticed only for its indication of the use in highpolymer chemistry.

The critical account by Harkins forms one of the best reviews in the volume and the section on Parachors rightly concludes with the statement, "The parachor is a useful additive function but not a reliable tool for deciding between alternative different possible structures."

The study of monolayers has proved a valuable tool in the investigations of organic and biological problems and rightly finds a place in the volume under review. The horizontal and vertical film balances are well described and all aspects of work in the field are considered. Attention is drawn to the absence of

temperature control in most of the work of the English school and the author is constrained to remark, "It is evident, however, that such methods cannot give high accuracy".

The chapter on Calorimetry gives a valuable account of the application of this method to the study of fast reactions while the one on Microscopy gives an organic chemist a bird's-eye-view of Chemical Microscopy as a tool for constant use. The remaining chapters maintain the general standard of the volume, the theoretical aspect being more prominent. The last chapter in the volume contains a useful account by Fajans on the additive characteristics of refractivity.

There is no mention of the price anywhere but a more serious omission is the absence of an index. One finds, for example, a table of the thirty-two classes of crystals according to the Schonflies Space Groups in the chapter on Microscopy while one would naturally look for it in the chapter on Crystal Form where it is not found!

The book will be found useful by advanced students of both Physics and Chemistry and also fulfils the demands of an organic chemist looking for a convenient tool for investigation. The equipment described is beyond the reach of most laboratories in this country but sufficient information is often found to enable one to build them up in a good workshop.

S. V. ANANTAKRISHNAN.

The Birds of Kutch. By Salim Ali. (Published for the Government of Kutch by Humphrey Milford, Oxford University Press), 1945. Pp. xviii + 175). Price Rs. 20.

This book follows the plan of treatment adopted by the author in his earlier publication, *Book of Indian Birds*, with which students of Ornithology are familiar. Though it purports to be the outcome of a survey it is eminently readable, having none of the harsh flavour of official reports. Assembled within the space of 175 pages is a body of interesting information of about more than 275 birds belonging to different groups, with special emphasis on features peculiar to Kutch and its close environs. The book is profusely illustrated. The photographic reproductions are excellent. The coloured plates are superb, all in perfcet conformity with the stimulating and enjoyable letterpress. Serious students of bird life will find the book helpful and inspiring, and those interested in a general way in the habits of birds occurring in their neighbourhood will find it fascinating.

Before Mr. Salim Ali was invited by His Highness Maha Rao Vijayarajji to conduct the ornithological survey of his State in 1943, there have been other scientists like Ferdinand Stoliczka, Hugh Palin and C. D. Lester in the field since 1872, but none of them can be supposed to have enjoyed the opportunities which were accorded to the present author, whose efforts are reflected by the illuminating book he has produced. He declares that the birds of Kutch are fortunate in their rulers, whose love for these feathered subjects, extended frequently beyond the limits of field observation and sympathetic study. An article which H. H. Maha Rao Vijayarajji wrote in 1912 on Goose-Shooting in Kutch is reproduced from the *Journal of the Bombay Natural History Society* together with two photographs, which tell a gruesome tale of the destructive power of fire-arms in the hands of a bird-lover

From the standpoint of physical features, the State of Kutch, which is almost treeless, rocky and barren, with ranges of hills and occasional wooded valleys and with scarcely 14 inches of rainfall, may not be deemed very propitious for harbouring a plentiful stock of varied birds. The country is traversed by a wide stretch of sandy waste lying athwart the face of the country as a broad band from East to West, known as the Great Rann, which during the South-West Monsoon becomes heavily inundated "But the chief interest of Kutch Ornithology lies in the geographical position of this narrow strip of land relative to the mighty tide of migration that sweeps into India from beyond its northern and north-western boundaries and out again in the autumn and spring of each year". Kutch, therefore, standing at the junction of these migrational streams offers unrivalled opportunities for observation of the annual visitors, and Mr. Salim Ali suggests the erection of observation posts at suitable centres where competent observers would be in a position to collect information of great interest to science, throwing light on some of the obscure problems of the phenomenon of migration. Further the study of the influence of barriers on the distribution of birds, restricting their local migration offers fresh problems, for the Great Rann seems to have produced two "well-marked distinctions between resident bird-population of Kutch and that of the adjacent dry areas of Sind, Northern Gujerat, Western Rajputana and the northern portions of the Kathiawar Peninsula". The existence of the Great Rann, therefore, invests the resident bird-population of Kutch with a closer affinity with that met with in Gujerat than in Sind and Baluchistan.

The description of both resident and migratory birds is conveniently divided into sections of size, field characters, status and distribution, habits and nesting. The more serious students of ornithology are provided with brief paragraphs giving measurements,—"mostly wing and tail"—and other systematic details. Kutch is interesting to naturalists as the Great Rann is known to be the only breeding ground in India of the Flamingo of which the book provides a good description. The other features of this attractive book are a map, interesting prefatory and introductory notes and Index. We have no doubt that this excellent book will be placed in the libraries of all public and academic institutions, where we confidently hope that students of Biology will make the best possible use of its great treasure.

C. R. N.

Education in India To-day. By P. M. Limaye, M.A. (Published by Dr. D. D. Karve, M.Sc., Ph.D., Fergusson College, Poona), 1945. Pp. iv + 140. Price Rs. 2.

This book is the outcome of a tour to various educational centres in India in order to study the organization, practices and problems of schools and colleges. The itinerary given at the end of the book indicates the wide area covered by the author. The specific purpose of the tour, and the manner in which it was made possible for the author to undertake it, are explained in the Introduction.

The book is remarkable not merely for the information which it presents but more for the critical observations which it contains. Mr. Limaye is a retired life-member of the Deccan Education Society, and as such he naturally brings to bear a new and refreshing viewpoint upon all educational questions. His is a comparative study of the place which the Bombay Presidency occupies in the world of Indian educational progress. He starts with conditions in that part of India and surveys the various aspects of education elsewhere

Referring to the slow growth of literacy in the country he draws attention to the failure of Government to utilize private agencies in a larger measure. In a later chapter on private effort in education he criticises the Sargent Report for its departure from the repeated pronouncements of Government since 1854 (Wood's despatch) as to the need for implementing private agencies and private generosity in the establishment and maintenance of schools and colleges. He makes a powerful plea for improving the salary scales of all grades of teachers and criticises the niggardly policy of Government in the framing of grant-in-aid rules. In this connection he pays a well-deserved tribute to the selfless workers of the Deccan Education Society and to the staff of Fergusson College, Poona.

It is refreshing to note that the author does not uncritically endorse all the features of the Wardha Education Scheme but points out the dangers that we are in in the overemphasis of craft work. He is of the opinion that primary education cannot be rendered self-supporting.

The problems of secondary education are viewed in the light of the latest official reports of England and India, and the need for developing different types of schools with a practical bias is stressed. In a later chapter he reverts to the same problem and makes a critical survey of the proposals contained in the Reports connected with the names of Sir M. Visvesvaraya, Abbot and Wood, and Sir John Sargent.

The author has a great deal to say on University education. He discusses in some detail the aims of a modern University, the place of affiliated colleges in the scheme of higher education, the value of the tutorial system, the maintenance of examination standards, the study of English, and the promotion of corporate life in the colleges. A special sub-chapter is devoted to the proposed Poona University scheme.

Finally, in the closing chapter, brief references are made to certain educational projects and their possible application to Indian conditions. The book is throughou marked by earnestness and independence of thought, keen observation and critical judgment. The general get-up of the volume is good, but one would wish that more attention had been paid to the elimination of typographical errors. An index would have been useful.

D. S. GORDON.

Aircraft Engines, Vol. I. By A. W. Judge. (Chapman & Hall, London), 1945. Pp. xii + 492. Price 28/-.

Beginning with aerodynamics, it works through combustion, and fuels to carburettors, supercharging, cooling and altitude effect, with a final chapter which deals with the gas turbines and jet propulsion. Thoroughly up to date so far as published work permits, it deals in detail with the working principles of the subject and is profusely illustrated. The results of recent experimental work are summarised with the help of data and diagrams, and full references are given to the sources of work There is an index of subjects and authors, and an appendix which includes tables of standard atmospheres. The illustrations and the general lay-out are both excellent.

The book is of a convenient size to the student of the subject. It offers no examples to work out, a common defect in books of this nature, and so is a conveniently small work of references rather than a teaching book. As a summary of research and working principles, it should appeal both to the technical and the practical man, to the air force officer as well as the engineer.

R. G. HARRIS.

An Elementary Text-Book of Inorganic Chemistry. By Ramani Mohan Roy. (The Book House, Calcutta), 1945. Pp. viii + 506. Price Rs. 3-12.

This book forms a welcome addition to the large number of good text-books that are already available for an Intermediate student. The general plan of the book is designed to meet the requirements of the Intermediate syllabus of the University of Calcutta and the last chapter (38) dealing with Ba, Sr, Cd, As, etc., has not yet been added to the book under review. It has to be pointed out that the addition of this chapter is very important since the matter of this chapter is included in the syllabus of many of the Indian Universities. It is happy to note that principles of physical chemistry necessary to understand some of the chemical processes have been nicely dealt with at appropriate places and a good deal of stress is laid on the importance of working out numerical problems. The author has very well realised the difficulties of the teacher and the taught in introducing the subject of chemical formulæ and equations and has given the derivations of many of the difficult equations. It would have been far simpler for a student to derive the formula of a compound by dividing the weights of each of the elements in a gm. molecule of the compound, by their respctive atomic weights, instead of the classical G.C.M. method described in the book,

In his anxiety to make the text-book a self-contained unit, the author has devoted seven pages to give a brief outline of the qualitative analysis. The information given in this chapter is too meagre and the student has to consult text-books on qualitative analysis to get the required information. This chapter could have been very much enlarged by omitting unnecessary description of some elementary topics like filtration, construction of a barometer, etc. In spite of the author's attempt to give an account of 'manufacturing processes now in use', it is strange to find him devoting too much of space for Welden's method of manufacture of chlorine from hydrochloric acid. In fact the modern practice is to manufacture hydrochloric acid from chlorine. The author seems to think (p. 246) that chlorine is not manufactured on a large scale because the caustic soda that is simultaneously produced has no market. On the other hand, the problem of the day is to find new methods of utilisation of chlorine manufactured in the alkali industry. 'Sublimation' has been defined as vapourisation of the solid with or without passing through the liquid state; this mistake has to be rectified. The illustrations, *viz.*, heating of ammonium chloride for sublimation and separation of water from alcohol by fractional distillation, are not apt.

M. R. A.

The Charnockite Rocks of Mysore (Southern India). By B. Rama Rao. (Bulletin No. 18, Mysore Geological Department), 1945. Pp. 199, with maps, photographs and photomicrograps. Price Rs. 3.

This Bulletin is a detailed account of the results of twenty-five years of his investigations on the Charnockite and allied rocks of Mysore. It is divided into nine sections. The first section is an introduction to the study of charnockites, with special reference to the work done at different periods by the officers of the Mysore Geological Department. The older officers of the Department generally accpeted Holland's view of a plutonic igneous origin for these rocks. But, Rama Rao's detailed studies in the field and the laboratory have revealed a number of evidences in support of a metamorphoric origin for the charnockite rocks in Mysore. Section 2 gives, in brief, a classification of these rocks. The third section describes the chief distinguishing characters of charnockites in general. The Mysore rocks are similar in all the characters to the typical charnockites, except in showing certain differences, like variation in texture, absence of hypersthene in some rocks showing charnockitic characters, and the occurrence (though rarely) of sphene. Section 4 gives a general summary of the mineralogy of these rocks and stress is laid on the secondary origin of hypersthene in them. The fifth Section, the largest, gives detailed descriptions of the petrography of all the rock types belonging to the charnockite series, which include the following: ultrabasic, basic, intermediate, and acid rocks, the charnockite dykes, and the charnockitic rocks. Section 6 is a comparative study of the chemical compositions of the charnockites of Mysore with those of other areas. In Section 7 some important exposures (14 in number) of these rocks and their field relations to associated rocks are described with the help of maps. Section 8 gives briefly a comparison between the chrnockite rocks of Mysore and those of Holland's type area of Madras.

Section 9, the last chapter, deals with the most important question of the mode of origin of these rocks. It begins with a chronological review of researches on this subject. Next evidences collected in Mysore, favouring a metamorphic origin, are given. The age of the rocks in Mysore is also discussed. Rama Rao concludes that these rocks belong rather to a metamorphic province than to an igneous petrographic province, wherein "the combined series of alterations under different periods of metamorphism of a composite series of rock formations of different ages, have given rise to a series of hypersthene granulites of very variable composition".

The publication, being an exhaustive summary of the results of intensive work of over two decades on a variety of rock types belonging to the charnockites, will be welcomed as an important contribution to the literature on this complex series of rocks and is bound to help and stimulate further research in this field.

M. V. N. MURTHY.

SCIENCE NOTES AND NEWS

University of Travancore—Council of Research.—The Fifteenth Annual Report presented by Dr. K. L. Moudgill, Vice-Chairman, to the Council, records the progress of work for the year on a wide front. The general overall impression produced is that Travancore is fortunate in having an organisation which secures active and fruitful co-operation between industry and scientific research, each nourishing and being in turn nurtured by the other.

The Council proposes to open a Department of Applied Chemistry and, the establishment of a chair in Mineral Research has been made possible by a munificent endowment by Dr. Rm. Alagappa Chettiar. And, amongst the schemes already under way, mention may be made of a model salt factory to be opened in an area of 8 acres. The production of agar-agar continues. Pyrethrum plantations are to be extended to 100 acres. And, although the pyrethrin content of the Travancore flower 0·5 per cent., is modest, it is interesting to note that the stalks of the flowers are reported to contain as much as 0·13 per cent. pyrethrins—a finding which does not agree with much of the published work on the subject. Experi-

ments are also in progress on the production of charcoal from indigenous woods and on their destructive distillation. The most extensive data on this subject have been collected at the Mysore Iron and Steel Works, Bhadravati, and it would appear that co-operative endeavour in this field might well ensure avoidable duplication. A subject of great importance and of topical interest (the question was raised only this month in the House of Commons) is the State's resources in Monazite and Ilmenite with their potential bearing on atomic energy. The Council proposes to tackle this problem. The importance, complexity and resources needed for adequate and rapid progress in this field are such that perhaps India as a whole would gain and the State would lose nothing if the problem was taken up by an All-India Organisation. The Public Health Laboratory continue[a] its work on nutritional studies and on cholera vibrios. In the Applied Biology Section striking progress has been made in the Tapioca Farm which now has 72 varieties registered and where some 1,000 intervarietal hybrids have been raised. The Entomological Section has, amongst other problems, been working on a question of all-India interest -the susceptibility of bamboos to insect attack. Under Agricultural Chemistry, the work on soil surveys is being continued and a start has been made on base exchange phenomena in paddy soils. The Council has been able to secure the interest of private firms in the opening of deep-sea fisheries and curing yards which the Government propose to encourage.

The above are merely the high-lights of an interesting and informatory Report at the conclusion of which the Vice-Chairman points out that many of these schemes have been influenced by the stresses and requirements of war. We can only share his hope that the cessation of these abnormal conditions would not mean any diminution in the encouragement—in the broadest sense of the term—to the Council of Research of the University of Travancore.

Atomic Research Committee.—On the recommendation of the Board of Scientific and Industrial Research, the Governing Body has set up a Committee under the Chairmanship of Dr. H. J. Bhabha, F.R.S., to explore the availability of raw materials in India capable of generating atomic energy, suggest ways and means of harnessing them and keep in touch with similar organisations in other countries.

Schemes of Industrial Research.—The construction of a Technological Block of the Glass and Ceramic Research Institute in Calcutta at an estimated cost of Rs. 2,21,000, a block grant of Rs. 60,000 per annum to the Madras University for meeting the cost of a Leather Research and Technological Institute and a grant of Rs. 75,000 per annum to the Tata Institute of Fundamental Research, Bombay, for work on Astrophysics and Experimental Physics and Cosmic Ray Research, were lately approved at a meeting of the Governing Body of the Council of Scientific and Industrial Research.

American Road Experts to Visit India.—With the concurrence of Provincial Governments the Government of India have invited two top-ranking Public Works and Road Officials—Major-General Philip B. Fleming, the head of the Federal Public Works Administration, and Mr. Thomas Harris MacDonald, head of the Federal Bureau of Public Roads,—from the United States to pay a short visit to India, to advise generally on India's large programme of road development. Owing to their other important duties, the services of these two distinguished officials have been spared by the Government of the United States with great difficulty, but the President of the United States has agreed to their spending about one month in India during which time they will be the guests of the Government of India and will see as much of India's road system as possible in the time available.

British Aviation Experts for India.—The Civil Aviation Office of the Government of India is being expanded to meet the requirements of the programme for the development of India's air transport services and civil flying. As a first step towards this three specialist officers have been recruited in England. These officers who have taken up their appointments in Delhi are Air Vice-Marshal Sir Edward Rice, who becomes Deputy Director-General (Aircraft); Air Commodore E. I. Bussell, who has been appointed Director of Licensing, and Mr. J. P. Jeffcock, who becomes Director of Communications. Mr. Jeffcock is on three years' contract while both Sir Edward Rice and Air Commodore Bussell are on five years' contract.

Dr. P. V. Nair, M.Sc., D.Phil. (Oxon.), has been appointed Professor of Applied Chemistry in the University of Travancore. Dr. Nair is a former pupil of Sir Robert Robinson, Pres. R.S., Waynflete Professor of Chemistry in the University of Oxford, and worked at the Universities of London and Oxford.

We acknowledge with thanks the receipt of the following :—

BOOKS

1. *Vitamins and Hormones*, Vol. III. By R. S. Harris and K. V. Thimann (Editors). (Academic Press, Inc., New York, N.Y.), 1945. Pp. xv + 420. Price $6.50.
2. *Advances in Carbohydrate Chemistry*, Vol. I. By W. W. Pigman and M. L. Wolfram (Editors). (Academic Press Inc., New York, N.Y.), 1945. Pp. xii + 374. Price $6.00.
3. *Electron Optics and the Electron Microscope.* By V. K. Zworykin *et al.* (Messrs. John Wiley & Sons, Inc., N.Y.), 1945. Pp. xii + 766. Price $10.00.
4. *A Text-Book of Elementary Astronomy.* By Ernest Agar Beet. (Cambridge University Press, London), 1945. Pp. x + 110. Price 8/6.
5. *An Introduction to the Theory and Design of Electric Wave Filters.* By F. Scowen. (Chapmann and Hall, Ltd., London), 1945. Pp. xii + 164. Price 15/-.
6. *Roads for India.* By T. R. S. Kynnersley. (Tata Sons, Ltd. publication. Published by Messrs. Padma Publications, Bombay), 1945. Pp. 55. Price Re. 1.

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CURRENT SCIENCE

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TECHNOLOGICAL EDUCATION AND INDUSTRIAL DEVELOPMENT*

THE financial year 1945-46 has been marked by a remarkable progress in the planning of technological education and in implementing some of the plans. Almost all the provincial governments have published their post-war reconstruction and development schemes, and some of them have published the reports of their technical and industrial education committees. These envisage a large increase in the facilities for technical education of all grades and are based on the conviction that intelligent planning of vocations and of national resources both material and human is indispensable for rapid progress. I may give some relevant information from personal knowledge. In Bengal, plans have been practically approved for transforming the Sibpur and the Jadabpur Engineering Colleges beyond recognition and for improving the Calcutta Technical School into an up-to-date polytechnic. In Madras, the University has already opened centres of advanced training in Communication Engineering, Chemical Engineering and Leather Technology; and considerable progress has been made in starting new centres of technical education at Coimbatore, Vizagapatam, Bezwada, Calicut and Annamalai University. In the Bombay Presidency, the Engineering College at Poona and the Victoria Jubilee Technical Institute are rapidly implementing their well-considered schemes of development, and the University Department of Technology in its spacious new abode at Matunga, has, with the support of private benefactions, added to its well-established courses of Textile Chemistry and Chemical Engineering, the following new courses—technology of intermediates and dyes, pharmaceuticals and fine chemicals, foods and drugs, plastics, paints and varnishes and oils, fats and soaps. Mysore is building a magnificent occupational institute at a capital cost of twenty lakhs of rupees, a silk institute at a cost of seventeen lakhs of rupees, and is reorganising its textile institute at a capital cost of seven lakhs of rupees. The Central Provinces intend to establish "a national grid of technical education which will carry a constant flow of power into industry and commerce", and have planned the establishment for four polytechnics at Nagpur, Jubbalpore, Amraoti and Raipur and are enlarging the existing College of Science into a College of Science and Technology. The Behar schemes of technological education have been conceived on a more modest scale, specially in view of the possibility that her mineral resources may make her the hub of the industrial life of India. I believe other provinces and States are also busy planning similar developments. Nor have the Government of India at the centre been lagging behind. The Delhi Polytechnic is being

* Extracts from the Presidential Address delivered by Sir J. C. Ghosh, D.Sc., F.N.I., at the Annual General Meeting of the Association of Principals of Technical Institutions (India), March 1946.

expanded and equipped on up-to-date lines at a capital cost of twenty-three lakhs of rupees. Funds have been provided for opening in the Indian Institute of Science, Bangalore, depart-partments of Aeronautical Engineering, Internal Combustion Engineering, Metallurgy, High Voltage Engineering and Chemical Engineering, and the services of three experts from England have been secured for the first three departments. A scheme for opening in the Indian Institute, a department of Power Engineering is also under consideration.

The Government of India, however, are not satisfied that these provisions are enough. There are no two opinions now regarding the urgency of India's industrial development. The Defence Services are convinced that they can only be effective in co-operation with modern industries producing inexhaustible supplies at their rear. And even a much maligned Tory Secretary of State did not hesitate to declare in 1943-44 that "India has in her all the latent resources of raw materials, of power and of human skill to make her a great industrial country. The development of her own industries to the fullest possible extent, both for their own sake and in order to raise the standard of living of her population, is the natural and proper ambition of all patriotic Indians. I can say that the Government of this country (Britain) naturally want to see Indian industry developing to the fullest. The last thing industrialists in this country have in mind now is the idea that British export trade can best prosper by India being held back in the course of her industrial development". Effective industrial development is not possible without adequate number of trained industrial personnel. As a matter of fact, Government are convinced that finance will not be so much of a bottle-neck in post-war development as dearth of qualified technical personnel. The Indian Scientific Delegation which visited U.S.A. in the winter of 1944-45 were struck by the immense scale on which technological education and research had been fostered in that country. Following a discussion in the Board of Scientific and Industrial Research, the Hon'ble Sir Ardeshir Dalal felt that the time was now ripe for establishing in India a technological institute of the very highest grade comparable with the Massachusetts Institute of Technology. The Deparment of Education had already come to a similar conclusion; and accordingly a committee, representative of all interests concerned namely, business, applied science, technology, etc., met in April last and generally agreed that the "existing facilities were entirely inadequate both in quality and quantity to satisfy India's post-war needs." They expressed the opinion that in view of the size of India and location of her industries, the provision of four Higher Technological Institutes--one in the North, one in the East, one in the West and one in the South—would be necessary. They have suggested that one institute in Calcutta should be taken in hand immediately, and another in Bombay either concurrently or as soon after as possible. Preliminary estimates indicate that each institution of this type will require a capital expenditure of the order of 3 crores of rupees and a recurring expenditure of 67 lakhs of rupees. Considering the importance of the problem and its significance in our industrial structure, such expenditure is very much worth incurring.

Even if, as we hope, adequate funds are available, success of technological education of every type will depend on three factors—(1) recruitment of proper staff, (2) recruitment of proper students and (3) planned dovetailing of education with gainful employment. These are constant sources of headache to me—probably to all of us.

It often happens that the type of men we wish to have in our staff will refuse to respond to an advertisement, but can be had only after delicate personal negotiations. The public are on the other hand suspicious—and justly so, with so much nepotism evident in wartime—and demand that every appointment should be made in accordance with the rigid methods prescribed by the Public Service Commissions. I doubt if Sir Asutosh Mookerjee could have gathered round him such a galaxy of talent when he established the post-graduate departments of the Calcutta University by following such methods. I wish we could, in course of our deliberations, suggest a method of recruitment which will combine the flexibility of private negotiation with the scrupulousness of public service procedure.

It will also be unwise to ignore the existence of an unfortunate feeling in the country that foreigners should not be employed in important positions in the educational world. This is a short-sighted view which originated in those days—not long ago—when many third-rate British educators were appointed members of the Indian Education Service and automatically became senior to the best indigenous scholars, who had taken to education as a profession. One need not apprehend that such things will again happen in future. In our recent tour in the U.S.A., which is the most advanced country in the world in the field of technical education, we found that many European Professors of established reputation have been employed by the authorities, in the educational institutions and even in research projects of war-importance. To-day Russia is reported to be "kidnapping' the German scientists from her zone of occupation to serve Soviet technical institutions and industrial enterprises. India should not hesitate to invite experts of high standing from every part of the world, if necessary, for affording equal opportunity to Indians of all classes to acquire the highest technical knowledge and skill in their own country. It pays better to engage a foreign expert on £2,000 a year to train a dozen talented young Indians in the country itself than to send the same dozen overseas for similar training at a total cost of £6,000 per year.

This naurally brings me to a discussion of the problem of sending Indian students for training overseas. The wisdom of such a policy has been questioned recently. People should be assured that it is purly a *temporary* measure designed to train personnel required immediately for staffing our scientific and technical institutes and providing technical personnel for our rapidly developing industries; that Government fully recognise that public funds will be far better spent in equipping and staff-

ing first-rate technological institutes and scientific laboratories in India itself than in maintaining students abroad. Our memories of what happened in the past in this connection have not been altogether happy. Mediocre youngmen from well-to-do families have often gone abroad and on their return, with a degree from a foreign university, have been placed in responsible positions over the head of far more brilliant youngmen who have been trained in Indian educational institutions. Our appointing authorities have invariably ignored the fundamental truth that talent is a part of one's heritage and that education can only bring out latent talent but cannot, as the Bengali saying goes, make a horse out of an ass. A young man with an indifferent record of work in the educational institutions of our country must never, by virtue of some foreign degrees which he has acquired later by utilising his privileged economic position, be allowed to supersede the claims of those who were his betters in India, for responsible appointments. A clear enunciation of this principle will go a long way to remove the job-hunting psychology of young Indians going overseas. They will then try harder to master a subject or a technique than to get a mere degree during their sojourn abroad.

Selections for admission to all grades of technical institutions should be made purely on merit subject to the condition "that some proportion of the seats should be reserved for the educationally backward classes so that in due course the general level of education throughout may be raised". In the case of institutions maintained by central funds the student population should, as far as possible, be representative of all parts of India. I lay great stress on the provision of merit-*cum*-poverty scholarships. The worth of a State is the collective worth of the individuals constituting the State. Science is definite that ability is very widely distributed in the community, and that it would be of the greatest advantage to the country as a whole if opportunities for satisfactory training and scope for the play of such ability are most widely spread. The aim should be that every child regardless of religion, caste or income of parents be educated to the limit of his abilities. As a practical approach to that aim, our educational policy should ensure that poverty becomes no bar to talented boys rising to the topmost position to which they are entitled by virtue of their ability and character. This is the least that we should do in India to restore social justice. The provision of 400 merit scholarships and 400 poverty scholarships for a student population of 3,000 in the Higher Technological Institute is, therefore, very welcome.

We now come to the crux of our problem—integration of vocational education with gainful employment. The following observation of "Eavesdropper" in a recent issue of *Indian Finance* is worth quoting:—

"For centuries, education meant only the acquisition of the habits and mental outlook and equipment of a scholar. It did not include the capacity to make a living by giving the rest of society some consideration for letting you share in the total stock of food and clothing and other requisites of life. Indeed, work and the capacity to work were looked down upon by more than one race in history. Science languished for centuries because of man's contempt for manual work; and in India, science was virtually killed by confining manual work to the lowest class of Hindu society. The upper classes all the world over looked down on work; and the slump in self-esteem. which a consciousness of parasitism might cause, was sought to be prevented by the emphasis on the development of the mind, of culture and the like. Where culture was accompanied by pretensions to otherwordliness, the danger of education being purely lettered was even greater. Talks of true dignity of work were largely a fashionable bourgeois fetish, till the higher classes had to engage in manual work, if not for its own sake, at least as a necessary basis of technical and scientific knowledge. When the educational system supported by the State had to cater to the needs of children of the lower middle and the working classes, work and skill in work came to be included within educational aims and purposes. Training took a high place by the side of learning. The practical and social purposes of education began to be taken notice of as much as the ideal and the individual. The commonest error is to suppose that employment depends upon the content of education or the nature of the training, and not the demand for either. The error was not brought home till it was found that men with technical training had no better prospects of employment than men with a purely liberal education. The success of the educational system, from the standpoint of employment for its products, depends upon an economic organisation capable of absorbing the young men as they finish their courses of study and step out of their colleges. The student of to-day is the worker, even more than the citizen, of tomorrow. His place in office or factory must be ready there for him, earmarked well in advance of the completion of his studies. But the school or college will train him all the better for knowledge of the place he is to fulfil.

"The strong point of economic planning is that it brings production and employment together in the closest possible relation. It guards against a divergence between production and consumption by security of employment, and through it, steadiness of demand. And it ensures employment, not only by having an adequate programme of production, but also by ensuring employability. The primary function of an educational system which is designed as part of an educational system which is designed as part of an economic plan is to ensure the employability of its products at all levels and of all grades. The educational facilities will be determined by the proportion in which qualified men of various grades of attainment will be required in the different professions and crafts. It will ensure that the students entering the various departments do not exceed or fall short of the requisite number. It will be capable of speeding up or varying or intensifying the training of the students in each grade, when the progress of the plan requires such action to be taken. In other

words, education will be the handmaid of economic planning."

The sudden termination of hostilities in the East has made difficult transition of war-time industries to peace-time conditions. It has been estimated that 8 million persons in India are in the process of becoming unemployed due to cessation of war activities– about 7 millions engaged in small-scale and cottage industries for the production of goods required by the defence forces, ½ million in large-scale industries, ½ million engaged in transport, trade and office-establishments, and 1 million by demobilisation from fighting forces. 250,000 men in the last category, whose claims for re-employment should be given the highest priority desire to be absorbed in technical jobs. I do not know if any short-term plan has been prepared by Government to ameliorate this situation. My. personal experience has been rather unfortunate. I know many employees in the Hindusthan Aircraft at Bangalore. Out of the 12,000 technical men there, about 10,000 have been discharged already. Under the stress of the war, we opened in the Indian Institute of Science, a department of Aeronautical Engineering equipped with a large wind tunnel and were admitting 12 graduates in mechanical engineering of Indian Universities for a sixteen month's course of intense training in Aeronautical Engineering. As long as the war lasted these men were immediately absorbed in Aircraft establishments and we were even encouraged by such appreciative remarks:—"From what I have seen I can assure you that your ex-students are a credit to the Institute. I hope they will eventually form a sound nucleus on which to build up the aeronautical engineering industry in India. This industry must sooner or later become of primary importance". Most of them have now been thrown out of their jobs and we do not know what the present trainees are going to do. The trouble is that war being now over, the Bureaucracy may again forget that time is the most valuable asset in the life of a nation as of an individual, and they may again take upon themselves the duty that we make no mistakes, and make no wrong moves, with the result that the pious wishes of a Viceroy or a Finance Member may not get a chance to be translated into actual deeds. A practical idealist is he who, while aiming at the very best, is often satisfied, for the time being, with the second or third best; a short-term plan of post-war development covering all sectors of national life, quickly evolved and capable of immediate execution, is the need of the hour. We hope such a plan would be forthcoming soon.

VEGETABLE GHEE*

SPECIAL significance attaches to the Joint Discussion on "Vegetable Ghee", held during the Science Congress Week, in view of the increasing number of vegetable ghee factories which the Central Government are encouraging to be brought into being. The problem of the nutritional value of vegetable ghee was discussed in all its bearings and it was felt that the widespread and unrestricted employment of vegetable ghee in the Indian dietary, in absence of an authoritative and trustworthy pronouncement if its nutritional value or at least its innocuousness, was fraught with danger to national health. As Professor Damodaran of Madras pointed out, it is curious that in spite of the growth and prosperity of the industry, there was little information regarding its nutritive value Powerful vested interests have no doubt conspired to ignore certain facts about vegetable ghee since they would adversely affect their industry.

It is fortunate, however, that a few scientists in this country have interested themselves in the problem of determining the nutritional value of this product. Dr. V. N. Patwardhan (Bombay) who spoke at the symposium revealed that vegetable ghee adversely affected growth and reproductive function of animals. His researches have demonstrated that litters bred of rats maintained on vegetable ghee as the only source of fat, suffer from infantile mortality and the few survivors do not grow well. Dr. Patwardhan said that of the fats he investigated butter stood out as the fat *par excellence* viewed from any angle—growth, maintenance, reproduction and lactation. No particular nutritional advantage was derived by hydrogenation of a vegetable oil since the untreated oil was equally nutritive. On the other hand, information available from other sources indicated that the ill-effects of hydrogenated oils may manifest themselves in the second or third generation of animals brought up and bred on diets containing hydrogenated fats.

The refining and the hydrogenation of oils, the two essential processes involved in the production of vegetable ghee, are probably responsible for "devitalising" the oil and for depriving it of all the essential vitamins, unsaturated fatty acids and other growth-factors. Insect feeding experiments, conducted by Miss de Souza in the Section of Fermentation Technology, Indian Institute of Science, support this fact.

From the nutritional standpoint, the refined and hydrogenated "vegetable ghee" whose popularity is reaching dangerous proportions, is not only inferior to ghee made from butter but possibly harmful to the consumer. The verdict of the scientists who participated in the discussion was clear and unambiguous—consume butter if you can afford, otherwise take any of the ordinary edible oils, without any treatment, as the next best. It is interesting to recall that as early as 1930, during the symposium on the same subject held in Bangalore, Mr. P. Ramaswami Ayyar, of the Indian Institute of Science, put forward the same view. He suggested a blending of the vegetable oils followed by a suitable treatment so as to invest the mixture with the flavour of natural ghee. It is regrettable that this rationalised suggestion has not been adopted.

The Government and their departments of health will have to make these facts widely known in the larger interests of public health.

* A critical summary of the proceedings of a symposium on the subject held during the Science Congress Week at Bangalore, 1946.

SUNSPOTS

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SUNSPOTS have been known since the third century of the Christian Era. Oriental records contain observations of 45 sunspots made between A.D. 301 and 1205. But in the western world, soon after the invention of the telescope, the discovery of sunspots appears to have been made in the year 1610 independently by Galileo, Fabricus and Schneir-Fabricius being the first to publish the fact. Scheiner at first maintained that the dark spots were due to the transit of small planets across the sun's disc, but Galileo and Fabricius from the very outset of their observations correctly recognised that they are objects on the sun. The thought of blemishes on the sun was, however, repugnant to medieval society dominated by theological philosophy and it was a long time before the existence of sunspots was grudgingly accepted as a scientific fact. From then onwards observations of sunspots have been fairly continuous, but really systematic observations, visual as well as photographic, have been made only during the last sixty years or so leading to many important discoveries concerning the nature of these objects.

Sunspots can be observed through a very small telescope of even an ordinary field or opera glass. The safest way to observe them is to point the instrument at the sun and focus the eye-piece until a sharp image of the solar

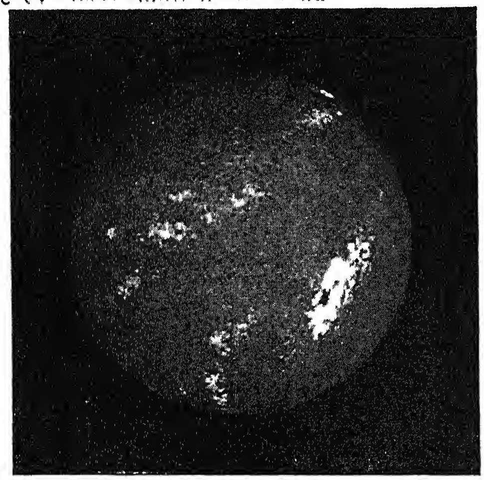

FIG. 1

disc, several inches in diameter, is projected on a white cardboard. A careful examination of this projected disc reveals that the sun has a mottled appearance, particularly near the edges. Now and then, on the mottled background dark spots appear, occasionally several times larger than the earth. They often occur in groups and many groups of sunspots have been observed covering areas of one hundred thousand square miles or more. Recently, a large group of spots, about twenty times the size of the earth in area, was observed between 30th January and 12th February 1946 (Fig. 1).

Spot areas are usually measured in millionths of the sun's visible hemisphere. If the area of a spot is more than 1000 units or about 25.000 miles in diameter, it can be seen by the naked eye when the brightness of general sunlight is reduced by the use of a shade-glass, or by thin clouds, or by nearness to the horizon. Evidently, the ancient Oriental records of sunspots refer to those observed with the naked eye and, therefore, contain no details of their structure. Modern telescopic observations, particularly those made by exceptionally skilful observers like Langley, Nasmyth, Secchi and a few others, have revealed a wealth of detail in the structure of sunspot which has gone a long way towards elucidating their real nature.

Although the structure of a solar spot varies very considerably during the period of its growth, a well-formed sunspot consists of two characteristic portions—a central, more or less circular and very dark region called the *umbra* and a surrounding fringe called the *penumbra* which is less dark and consists largely of filaments directed radially inwards. As Young has said the general appearance of a mature sunspot is "as if the umbra were a hole and the penumbral filaments overhung and partly shaded it from our view, like bushes at the mouth of a cavern". Fig. 2 which is a copy

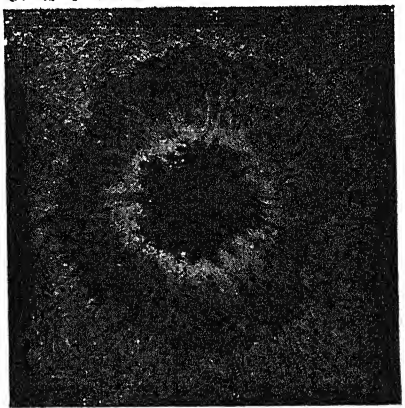

FIG. 2

of a drawing by Secchi, is a fair representation of such a spot under ordinary conditions of seeing. It will be noticed that the form of the spot in the drawing is nearly circular which is the ordinary form of a middle-aged sunspot, but during periods of formation and of dissolution a spot usually has a much more irregular shape. It will be seen also that there is no gradual shading off, either between the umbra and the penumbra or between the penumbra and the surrounding photosphere; in fact, the penumbra is clearly separated from the umbra by a bright ring and on the photospheric side it has a strongly marked dark boundary. These and many other details visible through a good telescope under good circumstances of seeing make the observation of

sunspots one of the most fascinating experiences of astronomers.

If we watch a sunspot for some time we see it move steadily from east to west in a circle parallel to the sun's equator until it disappears at the western limb and if it is a long-lived one we see it reappear at the eastern limb after about a fortnight and sensibly at the same parallel of solar latitude. This movement is, however, only apparent because in reality the spot has very little proper motion of its own and is carried along by the east to west rotation of the sun about its polar axis. This apparent east to west movement of the solar spots is so regular and so largely independent of their individual characteristics that it affords a very convenient and fairly reliable method of measuring the period of rotation of the sun. Since spots are found to occur at all solar latitudes from 5° to 45° north and south of the solar equator it has been possible by this method to determine the periods of rotation of the sun at latitudes between 5° and 45° and it has been found that the sun's rotation is quite unlike the rotation of a solid body, for example the earth or the moon; for, the sun's rotation period is about 25 days near the equator increasing steadily at higher latitudes to about 27½ days at 45°. This curious feature of solar rotation has been verified also by several other methods of measurement which have also shown that the period of rotation continues to increase steadily right up to the poles where it is about 30 days. Of course, a spot in order to be suitable for the measurement of solar rotation must be visible for a fairly long time and the longer the life of a spot the more usable it must be for the unrpose. The life of a sunspot varies from a few hours to many months, the longest duration so far recorded being 18 months. The average life of a spot may, however, be taken as two or three months. We have said above that a spot has very little proper motion; this statement is, however, true only for a spot in its middle life, for a spot in the early stages of its life as well as when it is nearing dissolution shows very considerable proper motions. It must be mentioned also that when a large spot breaks up into two or more parts, as often happens, the parts fly asunder with velocities of the order of hundreds of miles per hour. But apart from the large and irregular proper motions which actively changing spots show, even the stable sunspots have a regular proper motion which is very small, but by no means quite negligible. According to the observations of Carrington spots between 20° north and south latitudes have a slight tendency to approach the equator, the movement amounting to a minute or two of arc per day, and outside these latitudes their tendency to approach the poles is much more pronounced.

As already stated in the preceding paragraph a sunspot can appear at any latitude between 5° and 45° latitudes north and south of the colar equator, but within these belts, often called sunspots belts, the distribution of spots is quite irregular. Between latitudes 10° and 30° the frequency of spots is highest, while beyond 40° and in the neighbourhood of the equator sunspots are rarely observed. Also between the sun's northern and southern hemispheres there is often a great inequality with regard to the number of spots, although over a very long period of years this inequality practically disappears. If one observes sunspots regularly for a number of years, one is bound to be struck by the fact that the total number of sunspots observable at any time and their areas vary not only from day to day, but from month to month and from year to year. A little more careful examination of observations ranging over a long period of years shows further that this variation is not irregular. In fact as early as 1776 Horrebow had already noticed it and had expressed the view that it was periodic. But the definitive discovery of the periodicity of sunspots and the determination of the length of the period we owe to Schwabe, a German pharmacist who, in 1843, announced his results after studying sunspots with unremitting patience for eighteen years and who continued his observations almost daily until 1868. Schwabe gave about ten years as the length of the sunspot period, that is, the time that elapses between one maximum of spot activity and the next. This figure was modified by later workers who used also data prior to Schwabe's observations as well as later data. The accepted figure for the length of the sunspot period is at present 11·13 years. But a Fourier analysis of all available data has revealed at least three more periods, viz., 8·36, 4·8 and 13·5 years. Not only do the number and the areas of spots show this periodicity, but also the position and the distribution of sunspots over the sun's surface vary in a periodic manner. This was demonstrated by Spoerer who, in 1880, discovered an empirical law, sometimes called *Spoerer's Law*, according to which the mean heliographic latitude of spots from one minimum of the sunspot cycle to the next steadily decreases; this, of course, is in agreement with Carrington's observations mentioned earlier. At a sunspot minimum the solar disc may be entirely free fro mspots for weeks and even months. But broadly speaking, about two years before the occurrence of a minimum some spots begin to appear in the neighbourhood of latitudes 30° north and south; these zones of maximum spot frequency drift towards the lower latitudes and by the time they reach about latitude 16° in both hemispheres, the next maximum of the sunspot cycle occurs. The zones of maximum spot frequency continue to drift towards the equator until the spots completely disappear in the neighbourhood of latitude 3° north and south of the equator. By this time already two more zones of spot activity have appeared in the neighbourhood of latitudes 30° north and south. Thus, at a sunspot minimum there are four spot belts—two near the equator due to the expiring cycle and two more at latitudes 30° north and south belonging to the next cycle. The cause underlying these peculiarities of distribution of sunspots must be intimately connected with the origin of the spots themselves, but at present it must be regarded as one of the unsolved mysteries of solar physics in spite of many attempts at its elucidation, notably those of Bjerknes and Rosseland.

From the practical point of view, the question whether the periodicity of sunspots has any notable influence on the earth is even more important than the problem of the cause of sunspot periodicity. There are undoubtedly several kinds of terrestrial phenomena which are closely associated with sunspots and are characterised by the same periodicity as sunspots. Among such phenomena may be mentioned the auroras, the changes in the earth's magnetic field and the frequency of short-wave radio fade-outs. Various claims to the discovery of a parallelism between sunspot periodicity and the periodicity of other terrestrial phenomena have been made from time to time; some of them may eventually prove to be correct, but at the present state of our knowledge we must regard them as unestablished.

The most obvious characteristic of a sunspot is, of course, its darkness; but this darkness is not of the same type as the darkness of a piece of coal compared to a sheet of white paper. If the light from the rest of the solar disc could be completely screened off, the darkest sunspot would shine as brightly as a powerful arc lamp. It has been found by radiometric methods that the temperature of a sunspot is of the order of 4,500°, while the temperature of the background or photosphere is about 6,000 and, therefore, the darkness of a sunspot is only apparent. This is confirmed also by spectroscopic data, for the spectrum of a sunspot differs from that of the photosphere in exactly the way one would expect considering the difference in temperaturee. For example, a large number of Fraunhofer lines which are strong in the photospheric light are weakened in the spot spectrum, while a number of other lines which are weak in the spectrum of the photosphere become considerably stronger in the spectrum of sunspots. Among these characteristic differences the most outstanding ones are the following: the lines of hydrogen are weaker in the spot spectrum than in the spectrum of the photosphere ; on the other hand, the line due to the neutral calcium atom (4227 A°) is very much more intense in the spectrum of spots than in that of photosphere. These and many other similar differences between the photospheric and spot spectra indicate that the temperature of the sunspot is considerably lower than that of he photosphere. The conclusion is also supported by the appearance in spots of certain molecular band spectra, such as those of titanium oxide, calcium and magnesium hydrides, which are scarcely perceptible or even non-existent in the spectrum of the photosphere.

Apart from the information regarding the physical state of matter in sunspots, the spectrograph and its variant, the spectroheliograph, have yielded information regarding the state of motion of the material of sunspots which is quite inaccessible to the ordinary telescope visual or photographic. Fig. 3 is a photograph by Mt. Wilson Observatory of a portion of the sun's surface containing a pair of spots taken in H-alpha light with the help of a spectroheliograph. A glance at the figure shows that there are curved formations strongly suggestive of spiral motion and strikingly reminiscent of the lines of force in the neighbourhood of a pair of magnetic poles. The occurrence of such remarkable features in spectroheliograms made Hale suspect that a sunspot might be a variable magnetic pole and that it might at the same time be a gigantic whirl in which electrified particles were in a state of circular motion thereby causing a magnetic field. In 1908 Hale confirmed his suspicion by his brilliant discovery that many lines of the spot spectrum show widening and even doubling or tripling similar in every way to Zeeman-effect. He also proved that in a spot pair (which is the common type of spot formation) the two constituents have opposite polarities. The intensity of the magnetic field varies from one spot to another; in some spots fields up to 4,000 gauss have been observed. The measurement of such weak fields by means of the Zeeman-effect is naturally a very difficult process, so that our knowledge about many important questions concerning the magnetism of sunspots, such as the direction of rotation and the sign of the charge of the electrified particles supposed to be responsible for the magnetic field, is necessarily very meagre. Our knowledge of motion of matter in sunspots, however, made a great step forward when Mr. Evershed at Kodaikanal Observatory made the discovery known as the Evershed-effect which ranks as one of the outstanding contributions to solar physics. In 1909 Evershed showed that in the lower levels of sunspots there is a movement of matter in a direction radially away from their centres and parallel to the sun's surface. He also found that this movement from the umbra towards the exterior is accelerated and attains a speed of about 2 km/sec. at the outermost edges of the penumbra. Evershed's discovery was followed by the works of St. John at Mt. Wilson Observatory who confirmed Evershed's conclusions and showed besides that in the higher levels of spots the movement of matter is precisely the opposite ; *i.e.*, matter flows towards the centre of the spots. The general picture (Fig. 4) of the motion of matter in sunspots which emerges from the researches of Evershed and St. John is that above a certain level in the

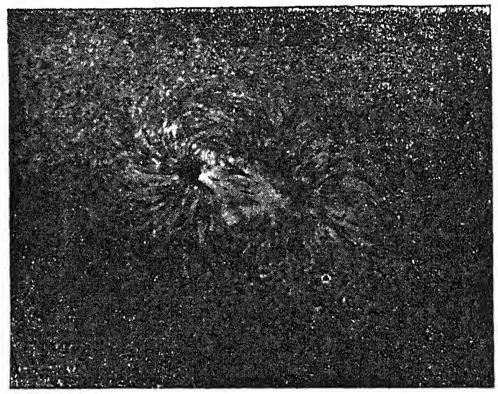

FIG. 3

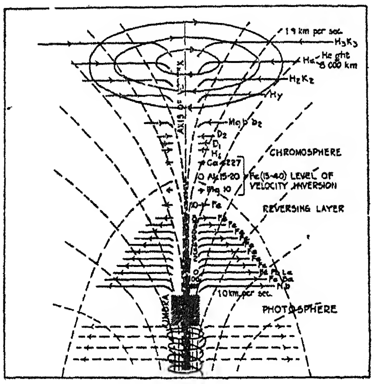

FIG. 4

interior of a sunspot (which may be called the inversion level) the motion is inwards (that is, towards the axis of the spot) and downwards, the speed increasing with height above the inversion level where the velocity is zero; while below the inversion level the motion is outwards and upwards, the speed increasing with distance below the inversion level. Thus although even in scientific literature sunspots are often likened to terrestrial cyclones on a gigantic scale, the motion of matter in a sunspot is the very opposite of what one finds in a terrestrial cyclone. Indeed the motion of matter in sunspots is very complex and although some of its details have been revealed by spectroscopic technique a great many more have yet to be discovered before one can hope to unravel the mysteries of the origin and the maintenance of these whirlpools of immense dimensions.

D.D.T., 666 AND INSECT PESTS OF STORED GRAINS

BY M. MAQSUD NASIR

(Imperial Agricultural Research Institute, New Delhi)

THE axiom 'Necessity is the mother of invention' holds true, especially during the days of war when problems not seriously attended to before are solved quickly. The Entomologists too kept pace with other scientists in the second World War and were able to demonstrate the utility of substances like Dichlorodiphenyl-trichloroethane (D.D.T.) and Benzene hexachloride (666) for the control of insect pests. These substances have been known from 1874 and 1825 respectively and are highly poisonous to insects but are not so to animals and as such are undoubtedly of great value in the control of insects infesting fruits, vegetables and stored grains. The low volatility of these substances unlike naphthalene and camphor, keeps them effective for a longer period. Thus they embody one of the important properties which an ideal insecticide should possess. Another advantage which renders them the champion of all insecticides is that they act both as stomach and contact poisons and are insoluble in water. They dissolve readily in petroleum oils and do not react with strong acids, however, the alkalies do affect their composition but alkalies in traces as found in dry ashes, coal ash clinker, lime, etc., have little deleterious effect upon their efficiency at room temperature; this was ascertained from mixing experiments where different dusts were used for diluting these insecticides. They act as nerve poisons affecting the muscles and causing death by paralysis.

Benzene hexachloride is non-poisonous to human beings and animals in quantities recommended against insects. Recently Dr. Slade stated that the 'gamma' isomer of benzene hexachloride known as 'Gammexane' is about five times more toxic than D.D.T. and that 30 milligrams of 'Gammexane' per day for five weeks or 100 milligrams of the mixture of isomers for two months could be fed to rats without any untoward effect, while the actual amount of 'Gammexane' required to give 50 per cent. kill in six days in case of *Calendra oryzæ* was 0·7 parts per million of the weight of grains. Although there appears to be little or no danger to animals by the use of 666, care must be exercised in handling it. D.D.T. on the other hand is somewhat toxic to animals and hence needs special care in treating materials meant for human consumption. Prolonged smelling of the two substances causes giddiness and the brain gets fagged, but these conditions disappear in three to four days' time. The substances when handled in the form of solutions in vegetable oils without proper precautions, get absorbed through the skin and cause slight shivering of the portion of body which remains exposed for a longer period.

As regards insects, the effect was noticed to be greatly pronounced in case of adults of *Sitotroga cerealella* and *Corcyra cephalonica*. The moths soon after coming in contact with the treated grains, appear very much disturbed and excited. They struggle in vain to penetrate deep into the grains. The whole body appeared to be shivering till the insects found apparently dead were seen with their genitalia pulled out and moving in a characteristic fashion.

In coleopterous insects, the effect in its initial stages is in the form of 'paresis'. The senses are benumbed and the legs are paralysed first and rendered of little use to have firm hold on any object. The effect is more pronounced in case of *C. oryzæ* and *Bruchus affinis* where the wings also get paralysed and shortly after the stupor increases considerably. The insects behave somewhat like an intoxicated man; they stagger and fall frequently as the 'paresis' increases. The insects are incapable of feeding

as the nerves controlling their mouth-parts get paralysed. In their last moments, the activity decreases considerably and they are found apparently dead before they succumb completely with their wings remaining stretched, especially in case of *C. oryzæ* and *B. affinis* (Figs. 1 and 3).

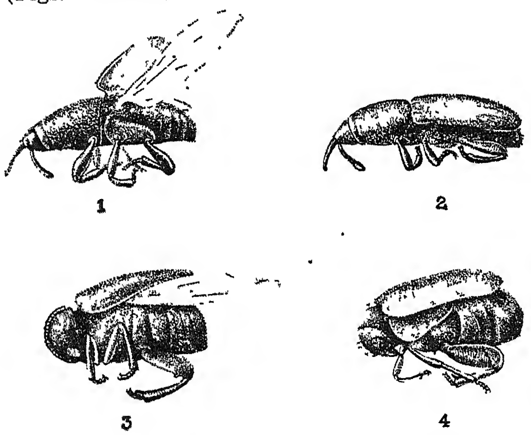

FIG. 1. Death due to D. D. T., or 666 (*Calandra oryzæ*, adult size ×9).

FIG. 2. Natural death (*Calandra oryzæ*, adult size ×9).

FIG. 3. Death due to D. D. T., or 666 (*Bruchus affinis*, adult size ×9).

FIG. 4. Natural death (*Bruchus affinis*, adult size ×9).

These observations are based on a variety of experiments performed in 1944-45 where grains were treated at the rate of 1/5,000 and 1/10,000 and the poisons diluted with chalk in a portion of 3 to 89. Complete mortalities were achieved in about three days' time in case of adults of *C. oryzæ*, *Rhizopertha dominica*, *Tribolium castaneum*, *S. cerealella*, *C. cephalonica* and *Trogoderma khapra*. It is interesting to remark that the larvæ of these insects are somewhat resistant and may require fifteen days or even more for complete mortality; grubs of khapra beetle were the most resistant and complete mortality could not be achieved even after seventeen days. They moulted and pupated normally but appeared attenuated.

Observations were also recorded in case of experiments where the insecticides were used in whitewash at the rate of 0·1, 0·2, 0·4, 0·6 per cent. and about 10 c.c. of the wash was used to cover an area of 1 sq. ft., to note their action. It was seen that only 0·6 per cent. dose could paralyse and kill *C. oryzæ* to a state of stretched wings. Lower doses also killed but had not the same type of paralysing effect. This observation was further confirmed when it was noticed that a dose of 1/5,000 as dust could not kill *T. castaneum* in the above-mentioned state, *i.e.*, stretched winged, while very high doses could cause slight stretching of hind wings in some cases.

666 was quicker in action than D.D.T. and a larger number of insects died with stretched wings.

The observation on the stretching of wings will be useful while experimenting with these poisons and will enable one to discriminate whether the insects are dying as a result of the poisons or due to some other factors.

The author takes an opportunity to thank Dr. H. S. Pruthi, Plant Protection Adviser to the Government of India and Director, Locust Control, for his unfailing interest and guidance in the work; Dr. T. Ahmad, Second Entomologist, I/C Division of Entomology, I.A.R.I., New Delhi, for the constructive criticism; and Mr. D. Badri, who prepared the drawings.

1. Pruthi, H. S., and Nasir, M., *Indian Farming*, 1945, **6**, (2) 506–10. 2. Slade, R., *Hurter Memorial Lecture*, Liverpool, 9th March 1945 (unpublished).

A MUSEUM OF EVOLUTION

BY PROF. B. SAHNI
(*Lucknow University*)

MR. M. S. RANDHAWA is well known to his friends as a practical idealist, and his suggestion for the creation of a Museum of Evolution[1] at a suitable centre in India is both apt and opportune.

We may have our own views on the origin of communalism and similar institutions in this country—and they would well repay study on evolutionary principles, even in the proposed Museum itself. But our support to the idea of organising a Museum or Museums of Evolution in India can be based upon other grounds, equally urgent.

As an instrument of popularising science, the museum method is valuable in view of its direct, though unusually silent, appeal to the inquisitive mind. Of course no public museum need, or should, be a silent instructor. As Mr. Randhawa suggests, short conducted tours through the museum, film talks and demonstrations are an important part of any such museum's functions. Provided the conductors employed are of the right calibre they can go a long way to put life into the exhibits. The conductors need not all be regular members of the museum staff: selected teachers and senior students from a local college or University may, for instance, be invited occasionally to explain sections of the museum in which they are specially interested.

It has been said that a good museum is a series of explanatory labels illustrated by a few specimens. The emphasis on the explanatory text is correct but I venture to suggest that, apart from the written and the spoken word, a careful selection of the illustrative material and its logical arrangement, is of the utmost value. In this respect I believe an ideal museum is—or was—the Deutsches Museum at Munich: I do not know if it has survived the havoc of the war.

In that museum I have spent day after day without feeling the museum-walker's fatigue. There was no overcrowding of dull exhibits,

no bewildering multiplicity of routes to follow. One-way traffic was enforced: portions in which one was not interested was simply passed by and one knew what one was leaving out. Pains were taken to arrange the material in each section historically—an excellent idea which gave a perspective view of the whole subject, so valuable to all students. A striking feature was the number of *original specimens* exhibited: for example, the historic Magdeburg hemispheres were there in the original, with a wonderful mural painting of the colourful scene when two opposing trains of horsemen failed to pull the exhausted hemispheres apart, to the amazement of a distinguished gathering of dukes and duchesses. In the chemistry section exhibits from famous old laboratories were shown, including, for instance, some of Bunsen's own burners, Liebig's condenser, and so forth. A section, devoted to the evolution of the means of locomotion, was fascinating: quaint old velocipedes were on view, as well as the latest devices for fast motion through the air, on water and on land. I remember having been approached as a possible intermediary for acquiring a real Benares *ekka* for the museum. In a room by itself was kept the balloon which at that time (1912) held the record for altitude, which I believe was only 10,000 metres. Rontgen's X-ray apparatus was also exhibited, as well as many other historic evidences of the achievements of modern science, such as the development of the wireless, and of the dye-stuff industry. What is more, one was allowed to operate a good many experiments, some of which were set up in show-cases or enclosures but could be worked by pressing a button or turning a handle; and a conductor was always handy. Lastly, some of the latest researches in each subject, specially those carried on within the country, were given a prominent place among the exhibits and demonstrations.

I cite the example of the Deutsches Museum —which in some ways was the pioneer, though now there are many other fine examples in Europe and America—in the hope that in the planning of a Museum of Evolution an attempt may be made to introduce some of these features, and the growth of our knowledge of evolution *in its widest sense* may be illustrated in the Museum with material collected from all possible sources.

To-day it may no longer be possible to secure any of the classical original material to illustrate, for example, the evolution of birds, or the history of Early Man; but with so much active research in progress, say, in genetics (to mention only one aspect of evolution) one could, by appealing to the original workers, obtain without difficulty a representative set of plants and animals illustrating their own current work.

Of fossil material there is no lack in the country, if only an organised attempt is made to collect. Field excursions can be held in co-operation with educational institutions and arrangements for exchange made with the Universities and colleges where geology is taught —of which, by the way, I hope there will be very many more—with the Geological Survey of India, and with museums abroad.

But the scope of the proposed Museum is very wide, and varied; much careful planning will be necessary, with perhaps, in the beginning, a somewhat restricted scheme of action.

Here are a few random subjects which might usefully be illustrated: The evolution of coinage; of linguistic scripts; of vestigial customs and their original significance; of boat designs; of pottery; of musical instruments; of footwear and of the modern coat-collar, neck-tie and coat-tail; of styles of hair-dress from the earliest times, through their heyday in the Gupta period, to their decadence and recent somewhat miserable attempts at rejuvenescence. All these, and many more, are little facets of the great edifice of Evolution which should find elucidation in the projected Museum. They would enrich the vision of the man-in-the-street as well as of the average student of biology whose conception of evolution is too often confined to text-book expositions of an all-pervading dynamic force.

But we must be prepared to appreciate one fact. The creation of such a museum—and we want more than one, with a re-modelling of some of our existing ones—will not alleviate some of the misfortunes to which reference is made in the opening paragraph of Mr. Randhawa's thoughtful article. Of some of these features of our life the causes lie elsewhere: but I dare not trench upon that field.

We already have a few decent museums in India. What many of our museums suffer from is not lack of exhibits but a lack of thoughtful planning, which comes from cramped space, cramped finances and, let us be frank, cramped vision in a system dominated by an unwilling and not always too intelligent directive. Have I not myself seen a fine collection of Siwalik vertebrates and other geological specimens, which must have cost great trouble and expense in collecting and naming, literally thrown into a heap on the direction of a certain old-time college Principal at Lucknow. He had the cabinets sold by auction because there was not room enough at the time for a proper museum in the college. Of the catalogue there was no trace left, and of the labels, alas, a few painted numbers remained to tell the tale of what had once been a collection of some scientific value. But this was a quarter of a century ago.

Mr. Randhawa's idea is full of promise for the future, and the benefits that result will be widespread. All who are interested in the advancement of Science and general knowledge in the country can do their part to help it forward.

1. *Curr. Sci.*, 1945, **14**, 284–85.

AGHARKAR FAREWELL COMMITTEE

THE Honorary Secretary of the Farewell Committee (Botany Department, 35, Ballygunge Circular Road, Calcutta) invites generous contributions towards the creation of a Fund for "commemorating his varied services to the cause of advancement of science in general and Botany in particular in India". Professor Agharkar's students, colleagues and admirers are requested to send in their contributions to the Secretary before 30th May 1946.

WAR AND INDIAN MINERAL INDUSTRY*

THE three most important minerals which are necessary for industry and defence of any country are coal, oil and iron. Other minerals are also necessary, but the ones mentioned above are of the highest importance. India, with the possible exception of U.S.A., is adequately endowed with large quantities of excellent iron ore, sufficient quantity of coal, bht so far as oil is concerned, the position is not very satisfactory. Regarding the other raw materials of defence, India has many of them in large quantities. She is no doubt poor in some metals and ores needed in highly technical modern defence industries, but she holds a few of the most important war materials in excess which can be profitably exchanged during times of war. The most important mineral needed in times of war is coal which is absolutely necessary both for transport and industry. Large portions of Indian coal comes from Bengal and Bihar. During the last War, Indian coal trade received an impetus and as the figures indicate the production jumped from 16,460,000 to 20,722,000 million tons. But during the present war, due mainly to lack of labour, the production fell considerably and between 1939-43, it showed a steady decline.

The oil production in India is too meagre to keep up to the abnormal demands of war periods. In order to cope up with this shortage, recent work has brought to light a few deposits in Punjab which may become important producers of oil in future. The other known oil deposits of India, of the type of Digboi, etc., recorded an increased production from 81 to 101 million gallons in 1941 but again showed a fall to 96 million gallons during 1943. During the recent war, Germany made good her oil shortage by producing oil from coal, but this process may not suit Indian conditions due to limited quantity of coal available. The geologists are of opinion that even if all known sources of oil is tapped, the same may not be sufficient to meet the ever-growing needs of the country.

So far as iron is concerned, India is fortunate in containing an abundant quantity of suitable ores of iron, but lack of sufficient quantity of coking coal has been a great handicap for this most essential and basic industry needed both in times of war and peace. Though manganese is becoming of lesser importance in wars, large amounts were, however, used in the steel manufacturing centres of the world. Indian manganese industry received a setback during the war mainly due to lack of adequate facilities for transport, but during the coming post-war period of all-round reconstruction, when unlimited quantities of steel is necessary, the position of Indian manganese will be more favourable. The recent discovery of low phosphorous manganese in Raigudda in Jeypore State is of importance in view of its proximity to ports in the east coast.

Muscovite mica has been an Indian monopoly for a long time, but in recent times Brazil has become an important producer of mica. World's electrical industries use a large quantity of Indian mica. It is possible that substitutes may be discovered for mica in post-war period, but electrical machines, designed as they are at present, have to use a large amount of mica and hence Indian mica industry, provided it keeps the cost down, is assured of its place in the world.

In order to step up production of raw materials to meet the increasing needs of the war demands in the country, a separate branch termed the utilisation branch was started in the Geological Survey of India. This was responsible for distributing improved equipment for mining and transport, which helped the Indian mining industry considerably. In some cases, the raw materials were subjected to a semi-finished process before exporting.

Beryllium is found to be very useful in copper alloys and during the war, U.S.A. needed a large quantity of this material and India supplied nearly 2,000 tons at Rs. 12 per maund. As a result of increasing demand, extensive prospecting was undertaken and numerous small deposits have been discovered in Rajaputana.

Ilmenite is found in abundant quantities in the beach sands of Travancore, and is the most important raw material for titanium white. Transport difficulties have adversely affected this industry, but future prospects of this mineral in the country is good.

Burma has been the chief producer of wolfram, and during the last War of 1914-18, she produced 4,542 tons, a record output, but later the Chinese ores replaced the Tavoy and Mergui ores from the world's market. India has really very small quantities of this material and during the recent war, a few smaller deposits were opened up for immediate needs arising out of the war.

Before the present war, Wawdwin Mines were producing the major quantities of zinc, lead and silver ores. But when Burma was overrun by the Japanese, the position of zinc became very serious, and immediately attention was paid to the old workings at Zawar in Mewar State. After locating a few lodes at depths, the work was abandoned.

India is singularly poor in sulphur, which is an essential mineral both during peace and war. During the recent war, there was great demand for sulphur for the essential industries chiefly producing war materials, and due to transport difficulties, when foreign supply was entirely cut off, the Government opened the Koh-i-Sultan deposits on the Persian border, and though this involved difficulties of conveyance, etc., it came in handy for urgent needs.

There was great demand for monazite prior to 1918, but after the electric lamp came into existence, the demand for this mineral decreased considerably. It is very necessary to locate the parent rock containing this mineral to investigate the possibilities of workable deposits in India.

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* Abstract of Dr. Crookshank's Presidential Address to the Sections of Geology and Geograpy, Indian Science Congress, Bangalore, 1946.

In India, Bengal and Bihar Provinces are the most important in any scheme of post-war activities, and since they contain the most economically important deposits, coal and iron, her defence must be of utmost importance.

The coal industry must be reorganised on a firm basis and it should not be allowed to deteriorate. Mining must be mechanised if necessary and the entire industry must be in the hands of skilled workmen devoted to their calling. The Government should hold a large reserve of sulphur for future consumption during periods of war, and for all this it is important to investigate properly the mineral deposits of India and obtain correct and detailed information regarding their extent, distribution and economic importance.

M. R. SRINIVASA RAO.

SHELLAC ADHESIVES AND CEMENTS

BY S. RANGANATHAN

(*Lac Information Officer, Namkum, Ranchi*)

THE remarkable property of shellac-strong adhesion to smooth surfaces, finds the widest industrial application in the manufacture of micanite; and sealing-waxes derive their adhesion to the paper surface from the shellac used in the compositions. The need for securing strong bonds between glass or metal surfaces which would be moderately heat-proof and perfectly waterproof in various industries has been met by effecting slight modifications through other added materials. Two typical recipes are given below:—

(1) Shellac 100 lbs., Creosote 10 lbs., Turpentine 4 lbs., Ammonia 1 lb.

The cement is generally used for glassware and scientific instruments.

(2) Shellac 7·5 lbs., Stockholm tar 5·0 lbs., Venetian red-oxide 20·75 lbs., Methylated spirit 1·0 gal.

This cement is used in munitions for filling, joining, and protection against moisture.

An adhesive prepared by dissolving 100 parts of shellac in 350 parts of water containing 15 parts of borax and 5 parts of sodium carbonate is useful for bonding paper and cardboard materials each other.

A bottle-top sealing composition consists of the following materials melted to a homogeneous mass*:—

Shellac 10 parts, Hydrolysed lac 10 parts, Castor oil 1 part.

A harder composition for topping corks is prepared as above with an additional 10 parts of mineral fillers.

An adhesive for making loudspeaker paper cones is made up of the following:—

Shellac 10 parts, Hydrolysed lac 5 parts, Water 30 parts. Liq. ammonia 2 parts.

In a recent article entitled "Adhesives based on shellac and its derivatives"[1] Mr. N. N. Murty has made a detailed study of adhesives, cements and glues and has given several useful recipes, their mode of application and particular preferred applications, a few of which are given below:—

Cement—

Shellac 50 parts, Hydrolysed lac 25 parts, Wet ground mica dust 24 parts, Malic acid 0·6 part, Tartaric acid 0·4 part.

Melt and mix the above at 110-120° C. for 30 to 40 minutes and apply the molten mass to hot surface and press gently. The cement is useful for joining core laminations of electrical instruments, bonding wood, fibre-board, etc., to metals and paper or cardboard scales to metal backs in meters, clocks, etc.

Adhesive paste—

Hydrolysed lac 98 parts, Tartaric acid 2 parts, Water 15 parts.

Mixed warm at 40-50° C. in putty mill and after spreading over the surfaces to be bonded, the joint is baked at 150° C. for 3 to 5 hours under light pressure. The material is particularly useful for sealing cracks in metals and castings, and for effecting metal to metal bonds.

Glue—

Shellac 100 gms., Tartaric acid 2 gms., Methylated spirit 280 c.c.

A shellac varnish prepared as above is quite suitable for bonding small rotars and fixing paper to metal and glass surfaces. The adhesion strength is greatly increased by baking at 180° C. for 1 hour under clamp pressure.

The addition of fillers like finely divided mica powder and slate dust results in greater toughening of the bond and the former also increases electrical insulation characteristics.

* Based on investigations at the Indian Lac Research Institute, under publication.

1 *Plastics*, 1945, **9**, No. 103.

SIR C. V. RAMAN, F.R.S., N.L.

SIR C. V. RAMAN has been invited to accept the Honorary Professorship of Physics of the University of Travancore. He has also been requested to advise the Government of Travancore on the preparation of a scheme of research to investigate the mineral resources of the State. Travancore's mineral resources, particularly the monazite, ilmenite and other mineral sands have, in recent months, attracted worldwide attention in view of the fact that these "sands" constitute potential sources of atomic energy.

LETTERS TO THE EDITOR

DISCONTINUITIES AND HYSTERESIS IN SORPTION IN RELATION TO THE CAVITY CONCEPT

The success of the cavity concept as a general theory of Hysteresis in sorption and other associated phenomena has been amply illustrated.[1,2] In porous adsorbents, sorption and desorption are mainly filling and emptying of capillaries. The mechanism of filling and emptying of the cavity and open pores produced by the juxtaposition of four spheres of equiradius has now been considered, and expressions have been derived for the extent of filling of the capillaries for different values of capillary radius.

FILLING OF THE CAPILLARIES

1st stage, formation and enlargement of liquid films between spheres.—With progressive increase in vapour pressure, the liquid film formed between two spheres enlarges and the edge becomes thicker, the thickness depending upon the relative vapour pressure according to Kelvin equation. If $2r$ is the thickness of the film at the edge, r_0 the radius of the sphere and θ the angle subtended by the meniscus of the film at the point of contact between two spheres, $r = r_0(1 - \cos\theta)$. Correcting for the curvature of the meniscus, the volume of six such films is given by

$$V_1 = 6v_a = 12\pi r_0^3\left(\frac{1-\cos\theta}{\cos\theta}\right)^2 \times \left(1 - \frac{\pi}{2}\tan\theta - \theta\tan\theta\right).$$

As the vapour pressure increases the films enlarge, the menisci of three films meet forming a circular opening at each neck between three spheres. This circular opening contracts as the film enlarges till its diameter is equal to the thickness of the advancing meniscus, *i.e.*, when r/r_0 is 0·138.

2nd stage, formation and thickening of liquid films at the necks of cavity.—Above 0·138 for r/r_0, the circular opening at the neck of cavity is unstable and a film is formed. With increase in vapour pressure, the film thickens. The thickness is given by

$$2h = 2r_0\sqrt{\frac{1-2\cos 2\theta}{3}}.$$

Applying correction for the curvature of the menisci the volume of each film is given by

$$v_b = 2h\left[r_0^2\left(\sqrt{3}-\frac{\pi}{2}\right)+\frac{\pi}{6}h^2\right]+\frac{3}{\pi}\cos^{-1}\frac{h}{R}\,v_a - \frac{2\pi}{3}\left(\frac{1-\cos\theta}{\cos\theta}\right)^3(2r_0^3 - 3h\,r_0^2 + h^3),$$

where R is the radius of the expanding film between spheres.

Volume of four such films at the necks together with the portions of films between the spheres is given by $V_2 = 4v_b$.

3rd stage, formation, contraction and collapse of the vapour bubble in the cavity and filling of open pores.—When r/r_0 is 0·183, the four liquid menisci meet in the cavity forming a vapour bubble. With increase in vapour pressure the bubble contracts till r/r_0 is 0·187. Above this, the vapour bubble collapses and the cavity is completely filled with liquid. Filling of the open pores continues till it is complete at the maximum vapour pressure. The volume of liquid during this stage of filling is given by

$$V_3 = 2v_b + 6\left[1 - \frac{1}{2\pi}\cos^{-1}\tfrac{1}{3} - \frac{1}{\pi}\cos^{-1}\frac{h}{R}\right]v_a + v_c,$$

where v_c is the cavity volume.[1] In calculating the expressions V_2 and V_3 certain approxima-

tions have been made owing to the complicated geometrical shape of the cavity and open pore. This, however, will not alter the qualitative nature of the conclusions.

EMPTYING OF CAPILLARIES

1st stage, emptying of open pores.—On lowering the vapour pressure from the maximum, the open pores are progressively emptied till the vapour pressure corresponding to the neck of the cavity is reached, *i.e.*, when r/r_0 is 0·138. The amount of liquid retained in this stage of emptying is given by V_0.

2nd stage, emptying of cavity and contraction of liquid films between spheres.—Below 0·138 for r/r_0, the films of liquid at the necks of cavity are unstable. So they disappear and simultaneously the cavity also is emptied. Later the films between spheres contract with decreasing vapour pressure. The volume of liquid retained is given by V_1.

From the foregoing, the volume (V) of liquid held by the capillaries for different values of capillary radius (r) at various stages of filling and emptying are obtained. The actual volume and the capillary radius corresponding to it depend upon the particle radius. The relative vapour pressure corresponding to the capillary radius is given by Kelvin equation. Calculation of the actual volume and the corresponding relative vapour pressure necessitates the assumption of an arbitrary value for particle radius. The mechanism considered above is true of any particle size. Therefore, instead of actual volume, V/V_0 is calculated for different values of r/r_0 (where V_0 is the total cavity and open pore volume and r_0 the particle radius, *i.e.*, the maximum capillary radius). The results are indicated in Fig. 1.

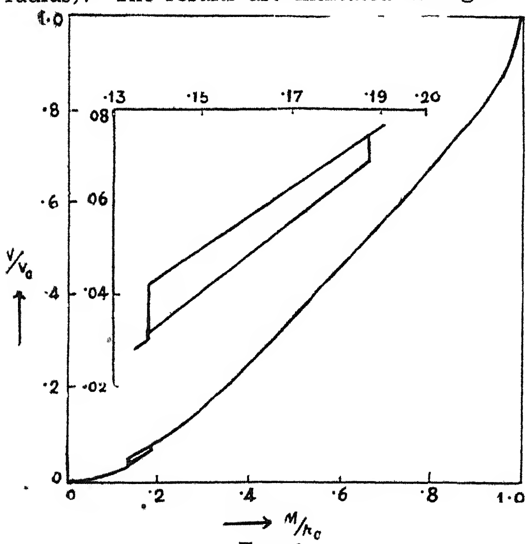

FIG. 1

The mechanism reveals the following characteristics :—

(1) The existence of the Hysteresis effect in sorption and desorption processes. The cavity produces the Hysteresis effect and its volume is very small in relation to the total capillary volume. The ratio is 0·013.

(2) Increase in the area of the Hysteresis loop with increase in cavity volume. The area of the Hysteresis loop depends upon particle radius. The cavity volume also is dependent upon particle radius.[1] The area is found to increase with increase in cavity volume.

(3) Discontinuities in sorption and desorption. During filling, the formation of liquid films at the necks of cavity, when r/r_0 is 0·138, causes a discontinuity. Later, in the filling of cavity, when r/r_0 is 0·183, there appears a bubble of the vapour which with increasing vapour pressure contracts and suddenly collapses when r/r_0 is 0·187, causing a discontinuity in sorption. Similarly during emptying when r/r_0 is 0·138, the completely filled cavity is emptied suddenly instead of progressively when the neck of the cavity is just emptied. This causes a discontinuity in desorption.

According to the cavity concept, the discontinuity should be much larger in desorption than in sorption. In the above mechanism, the discontinuity in desorption is 2·17 times greater than that in sorption.

The cavity concept affords a very interesting and convincing explanation of the vexed problem of discontinuities in sorption and desorption, first observed by Allmand and collaborators.[3,4]

Thus with cavities having constricted necks, sorption and desorption should be discontinuous as well as non-coincident. This non-coincidence, *i.e.*, the Hysteresis effect originates as a result of the entrapping of the liquid by the cavity. If there be no entrapping there would be no Hysteresis but the discontinuity, however, can exist owing to sudden collapse and formation of vapour bubble during sorption and desorption respectively.

In a porous system in actual practice, there can be capillaries of all shapes and dimensions. It is difficult to predict on theoretical grounds the magnitude of the discontinuity and whether it is measurable with the highest experimental accuracy known. Experiment alone has to decide this point.

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Central College,
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April 2, 1946.

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APPARENT MOLAL VOLUMES OF WEAK ELECTROLYTES

THE variation of Apparent Molal Volume (ϕ) of strong electrolytes[1] with concentration of solute (c) is governed by the interionic attraction theory equation : $\phi = \phi_0 + k\sqrt{c}$, the corresponding equation for non-electrolytes[2] being $\phi = \phi_0 + mc$, where ϕ_0, k and m are constants. The behaviour of weak electrolytes in this respect not being known, has been examined here by the author. For this purpose the data of Srinivasan and Prasad[3] on the density of solu-

tions of a number of weak electrolytes have been used.

It is found that the strong electrolyte equation $\phi = \phi_0 + k\sqrt{c}$ holds good for dilute solutions of weak electrolytes. To represent results over wider ranges of concentration, an expanded equation of the form $\phi = \phi_0 + k\sqrt{c} + mc$, in which an additional effect similar to that of non-electrolytes and obviously connected with the undissociated molecules is superimposed on the strong electrolyte character, has to be used.

The values of the constant k are in general of the same order as those for strong electrolytes of the same valence type. They also follow the order of dissociation constants.

Central Research Station,*
Dept. of Agriculture,
Pusa, A. S. CHAKRAVARTI.
March 31, 1946.

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* This work was done in the Chemical Laboratory, Science College, Patna.

ON A RELATION BETWEEN REFRACTIVE INDEX AND VISCOSITY OF LIQUIDS

A COMBINATION of the Lorentz and Lorentz[1] equation for Molecular Refractive Power:

$$\frac{n^2-1}{n^2+2} \cdot \frac{M}{d} = r$$

with Newton Friend's[2] Rheochor equation:

$$\eta^{\frac{1}{8}} \cdot \frac{M}{d} = R$$

(which holds good over wide temperature ranges in case of unassociated liquids[3]) leads to the relation $\frac{n^2-1}{n^2+2} = \frac{Y}{R}\eta^{\frac{1}{8}}$ between viscosity and refractive index of unassociated liquids. Here, n is the refractive index and η the viscosity; r and R respectively denote the Molecular Refractive Power and Rheochor.

It is well known that r can be calculated from atomic and structural constants; the same characteristic is exhibited by R as well.[4] The proposed equation should, therefore, lead to the refractive index from a knowledge of viscosity at the same temperature.

The equation was found to fit in with data on a number of unassociated liquids belonging to different families within a few tenths of a per cent. in most cases.

Central Station,*
Dept. of Agriculture,
Pusa, A. S. CHAKRAVARTI.
March 31, 1946.

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* This work was done in the Chemiccal Laboratory, Science College, Patna.

DEMETHYLATION OF 3-METHOXYFLAVONES WITH ALUMINIUM CHLORIDE

THE observation[1] that, when a polymethoxyflavone is submitted to the action of aluminium chloride under specified conditions, preferential demethylation of the 5-methoxyl takes place, has been utilised for the synthesis of several partially methylated polyhydroxyflavones and of 5:8-dihydroxyflavone. Examples are tectochrysin,[2] genkwanin,[3] primetin 8-methyl ether,[4] primetin,[5] and wogonin.[6] Hydrogen bromide in acetic acid at about 100° C. may be employed for the same purpose.[7] During the course of work on the constitution of calycopterin[7,8] it was also noticed that a 3-methoxyl, like a 5-methoxyl, is susceptible to demethylation by aluminium chloride and hydrobromic acid in acetic acid; and the preparation of 3-hydroxyflavone from 3-methoxyflavone by both the aluminium chloride and hydrobromic acid methods has been described.[7,9] Hydrogen bromide in acetic acid at room temperature was then found to attack the 5-methoxyl in preference to the 3-methoxyl. This modified procedure was suggested for the demethylation of the 5-methoxyl in calycopterin dimethyl ether (3:5:6:7:8:4'-hexamethoxyflavone),[7] leaving the 3-methoxyl intact, and the product was identified as calycopterin 4'-monomethyl ether (5-hydroxy-3:6:7:8:4'-pentamethoxyflavone).

These facts are recorded in view of extensions of earlier synthetical work in the flavone and *iso*flavone series which are now in progress in this laboratory. The references to the demethylation of the 3-methoxyl appear to have escaped the notice of Rao and Seshadri,[10] who mention that the use of aluminium chloride for partial demethylation was extended to the field of methylated flavonols by Krishnaswamy and Seshadri.[11]

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Department of Chemical Technology,
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Bombay,
February 25, 1946.

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STRUCTURE OF THE EARTH'S ELECTRIC FIELD

PHENOMENA in terrestrial electricity and magnetism present a paradox which has defied all attempts to explain them on the basis of known physical laws ever since they were detected nearly half a century ago. There is, for example, the question of (1) the cosmic radiations, which have been recently increas-

ingly considered to have their origin in the outer reaches of our own atmosphere,[1] (2) source of formation, by electron collision, of positive and negative ions in the atmosphere over the earth's land surface,[2] (3) seat of separation of the massive charge in a thundercloud,[3] (4) estimate of a non-vanishing terrestrial magnetic line integral,[4] and (5) existence of the anomalous mountain effect.[5] Whereas ordinary methods of measurement indicate a normal atmospheric electric field of only one volt per cm. at the earth's surface in fair weather, and much less at higher levels, all the above phenomena point either to the existence within the normal field of a component of more than 10^4 times this value or to a rectified atmospheric electric current arising from a component electric field of this latter magnitude.

In the opinion of the author, however, it can be shown that these apparent anomalies are but a natural consequence of the most generally accepted view of the origin of the earth's magnetic field (the internal core theory), and of the existence, even at very low levels of the atmosphere at the earth's surface, of alternately positively and negatively charged ionic layers.[6]

In a previous communication to this journal[7] the author showed that a positive layer of atmosphere at the surface is at an electric potential of 10^{13} volts with respect to the earth's interior, and that of a negative layer would be consequently negligibly in comparison. Assuming the latter to be zero, it may be shown that there would be a difference of potential and, hence, an equivalent electric field across any two such successive layers of positive and negative ions, of the order of 3×10^4 volts per cm. And this, we have seen, is of just the order of magnitude necessary to produce the foregoing phenomena.

While it would be premature to build a theory with our present unfortunate lack of observational data, the indications are that there is only one principle underlying all phenomena in terrestrial electricity and magnetism, somewhat on the lines indicated above, and unless we unravel it, our ignorance of the subject, particularly of the tremendous energies latent in the phenomena, may continue to remain for a very long time to come.

Colaba Observatory,
Bombay, ALFRED B. ARLICK.
March 18, 1946.

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CHEMISTRY OF KURCHI SEEDS PART I. ISOLATION OF A CRYSTALLINE GLYCO-ALKALOID

THE bark and seeds of kurchi (*Holarrhena antidysenterica*, N.O. *Apocynaceæ*) are reputed drugs of Hindu Materia Medica whose value has been repeatedly confirmed through clinical trials by successive Indian drug committees.[1,2] From the chemical point of view, the bark has received more attention from Indian as well as foreign investigators. The first chemical investigation of the seeds was started in these laboratories in 1926.[3,4]

A point of intriguing interest is that the crude bark juice or infusion of the seeds in milk is clinically more efficasious than any synthetic derivatives of the constituent alkaloids as evidenced by the marketing of tablets of powdered bark by Burroughs Wellcome & Co. On behalf of the chemical staff of this Institute, the possible importance of a chemical clarification of this difference of action between crude drugs in general and their isolated active principles has been discoursed at length by P. Ramaswami Ayyar in more than one Ayurvedic Conference.[5]

Though as many as sixteen different alkaloids have been prepared, mainly from the bark and to a lesser extent from the seeds by previous workers,[6] no systematic attempt has been made to ascertain the exact mode of combination of these in the crude drug. The present investigation is directly concerned with this problem.

The defatted kurchi seeds were successively extracted with a series of solvents yielding the results tabulated below.

Solvent	% of matter extracted
Ether	28·5
Absolute Alcohol	6·2
Benzene	0·6
Ethyl Acetate	1·3
95% Alcohol	12·5
Alcoholic hydrochloric acid (0·4 N)	3·3
Aqueous hydrochloric acid (3 N)	26·0
Sodium hydroxide solution (5%)	13·5

By systematic fractional crystallisation of the absolute alcoholic extract with methanol and ether, a light brown crystalline glyco-alkaloid has been separated in 1·4 per cent. yield on the weight of the seeds. The substance froths at about 65° and melts with decomposition at 200°. It is insoluble in ether, acetone and ethyl acetate, moderately soluble in methyl and ethyl alcohols and readily soluble in water. It reacts with benzoyl chloride to form a low-melting, pale yellow benzoyl derivative soluble in ether and acetone. The aqueous solution is extremely bitter, neutral to litmus, does not reduce Fehling's solution as such, gives moderate precipitates with alkaloidal reagents (Mayer's, picric acid, iodine in potassium iodide, and bromine water) and also a deep green colour with ferric chloride solution. After hydrolysis with 1:4 hydrochloric acid it gives copious precipitates with alkaloidal reagents and strongly reduces Fehling's solution.

Among the substances isolated from the

hydrolytic product are: (1) Conessine, m.p. 123-24°, melting point is unchanged on mixing with pure conessine prepared from the crystallised acid oxalate. (2) An ether-soluble viscous phenolic base giving a dense precipitate with Mayer's reagent in acid solution and a greenish brown colour with ferric chloride in alcoholic solution. (3) An ether-soluble, phenolic constituent readily reacting with benzoyl chloride to form a benzoyl derivative. (4) A sugar characterised by its reduction of Fehling's solution and the formation of an osazone, m.p. 195-97°.

Other constituents, possibly present in the hydrolytic product, as well as other properties of the glyco-alkaloid, are being studied.

I am thankful to Mr. P. Ramaswami Ayyar for suggesting this problem and giving guidance, and to Dr. P. C. Guha for kind interest.

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Bangalore, (MISS) R. J. IRANI.
April 5, 1946.

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SPECTROPHOTOMETRIC DETERMINATIONS OF IRON AND COBALT USING ISONITROSODIMETHYLDIHYDRORESORCINOL

ISONITROSODIMETHYLDIHYDRORESORCINOL forms a deep-red precipitate with cobalt and coloured solutions with iron, copper and nickel.[1]

Iron (ferrous and ferric) and cobalt were determined spectrophotometrically using isonitrosodimethyldihydroresorcinol. Spectrophotometric studies were made in concentrations from 0·5 to 10 p.p.m. of cobalt. In the case of cobalt 50 per cent. alcohol was used to keep the complex in solution. Spectral transmittance curves for iron, copper, nickel and cobalt were prepared. A linear relation between log of transmission and concentration was found. It is interesting to note that ferrous and ferric iron complexes have equal absorptions. The optimum conditions for measurements and the effect of diverse ions were determined. 2 p.p.m. of iron was estimated in presence of 150 p.p.m. of cobalt.

The principal advantages of using this method for the colorimetric estimations of iron (ferrous and ferric) or cobalt are its sensitivity, reproducibility and simplicity. Full details will be published shortly.

My thanks are due to Sir J. C. Ghosh for his kind interest in the work.

General Chemistry Dept.,
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Bangalore, S. C. SHOME.
March 20, 1946.

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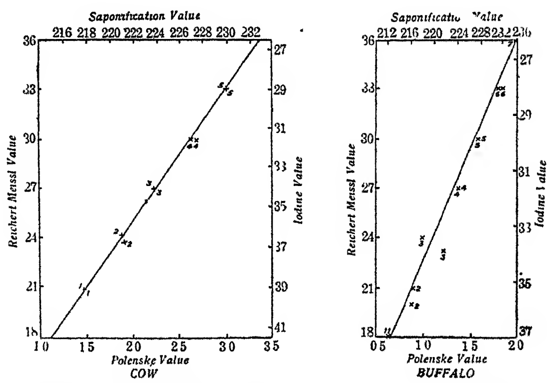
THE ANALYTICAL CONSTANTS OF GHEE

WHILE relationships between the analytical "constants" of butter-fat have been laid down in Europe, the Indian analyst in his detection of adulteration has often to go by the *individual* minima laid down in legal standards, the drawbacks of which are obvious. The relationship between the constants drawn up below after a study of 163 accredited samples of ghee from 18 tracts of India, using in addition the figures of Brahmachari[1] (50 samples of cow ghee, P.V. omitted) and Ghose[2] (233 of buffalo ghee, P.V. omitted, very narrow in range) indicated the average analytical correlations to be expected among the constants of cow and buffalo ghee. It should be of immense help to provincial analysts in the detection of sophistication. If they were to keep a record of data from accredited samples from their local ghee centres, they could draw up their own tables of relationship. and what is more important, of limits of variation with reference to some fixed value.

General Observations:—Colour: Cow ghee 5-6 and buffalo ghee 1-2 Lovibond Yellow units per gram; texture: cow ghee softer and more distinctly granular than buffalo, which is sometimes hard and waxy in consistency, especially when the R.M. is low, even though the I.V. is high.

Range of Constants.—These are shown in Table I.



Interrelation ship between the constants of Ghee,

The range for cow ghee is probably not exhaustive; the wide refractive index range is, therefore, the more remarkable.

Interrelationship between Constants.—These represent the *ideal average case* and their value is, therefore, as a yardstick against which deviations may be better judged.

A. Cow Ghee

R. M.	P. V.	I. V. (Wijs')	S. V.	B.R. at 40°C.
21	1·5	39	218	46·2
24	1·9	37	221	44·7
27	2·3	34	224	43·1
33	2·7	32	227	41·5
33	3·0	29	230	40·5

TABLE I

No. of samples	R. M.	P. V.	I. V. (Wijs')	S. V.	B. R. at 40° C.
Cow 44	16·9–28·1	0·9–3·2	31·0–45·6	212·8–232·8	42·5–47·7
Buffalo 119	14·5–39·9	0·4–5·3	21·4–39·9	198·0–239·3	40·9–46·9

The following observations arise: ((i) the R.M.-P.V. relationship is of the same order as for Western butter-fat; (ii) the I.V. are much smaller than those found in milk fats of European origin; (iii) the I.V., which is made up to the extent of about 80 per cent. by oleic acid, is inversely proportional to the R.M. value (comprising butyric and caproic acids). This tends to support the view of Hilditch and co-workers[3] that the two are related in production *in vivo*; (iv) an empirical ratio,

$$\frac{\text{S.V.}}{\text{R.M.} + \text{P.V.} + \text{I.V.}}$$

equal to 3·53, links the constants in each row of the above table.

B. Buffalo Ghee

R. M.	P. V.	I. V. (Wijs')	S. V.	B. R. at 40°C.
18	0·6	37	212	44·9
21	0·8	36	217	44·2
24	1·0	34	222	43·7
27	1·3	32	226	43·2
30	1·6	30	230	42·7
33	1·8	28	233	42·1
36	2·0	26	235	41·5

Features of interest are: (i) The P.V. are low in themselves and more so in comparison with the P.V. figures for cow ghee corresponding to the same R.M.; (ii) the mean unsaturation is less than that of Indian cow ghee (to the extent of about 3 units in each case) and much less than that of Western cow butter-fat; here are, therefore, two distinct chemical characteristics of buffalo ghee; (iii) the inverse R.M.-I.V. relationship points to the same theory of fat formation here as above[3]; (iv) the refractive index range is extremely narrow; (v) the value of the empirical ratio $\frac{\text{S.V.}}{\text{R.M.} + \text{P.V.} + \text{I.V.}}$ is again constant, but equal to 3·74.

Marked effects of feeding were only noticed with cottonseed-fed animals when the R.M. fell very low in both cases, though the analytical relationship shown above was maintained. The effects appeared to be more severe on buffaloes (*cf.* Patel *et al.*[4]).

Our thanks are due to the Imperial Council of Agricultural Research for financing these investigations, and to Prof. Subrahmanyan for his encouragement during their progress.

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Bangalore,
January 27, 1946.

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SUPPLEMENTAL VALUE OF BRAN EXTRACT IN PENICILLIN PRODUCTION

ORGANIC and inorganic supplements have recently been shown to influence the production of penicillin. Corn steep liquor[1] increases the yield of penicillin tenfold; 0 1 per cent. Difco yeast extract[2] exerts a similar effect. Aqueous extracts of freshly ground dried peas[3] constitute a good supplement for obtaining better mold growths and increased yields of the antibiotic. A two per cent. corn oil[4] is known to give an abundant and uniform mold growth and a higher quantity of penicillin. Trace elements, notably zinc[5], are shown to augment the formation of penicillin.

An increased yield of penicillin and a reduction in the period of incubation, have both been secured by the employment of moist wheat bran.[6] More recently,[7] the inorganic ash constituents of the corn steep liquor have been shown to be partly responsible for influencing the production of penicillin.

As a part of the comprehensive programme of investigating the microbiologically active principles of the wheat bran, the effect of acid alcohol extracts of the material on penicillin production, has been investigated. Basal medium enriched with graded dosages of the extract calculated on the basis of total nitrogen, was employed and the experimental procedure and the method of assay followed during these studies, were similar to those described earlier.[8]

The basal medium was composed of: commercial glucose 40 gm.; sodium nitrate 3 gm.; potassium dihydrogen phosphate 1 gm.; mag-

TABLE I

P. notatum—N.C.T.C. 1540. Test organism: *Staphy. aureus*—N.C.T.C. 2150.

Period of Incubation in days		Without extract	with extract corresponding to			
			0,2 mg. N_2	0·4 mg N_2	0·6 mg. N_2	0·8 mg. N_2
4	pH after fermentation	5·2	4·8	4·7	4·6	4·8
	Antibiotic activity	Nil	Nil	Nil	Nil	Nil
5	pH after fermentation	5·2	4·8	4·7	4·6	4·4
	Antibiotic activity	243 sq.mm.	396 sq. mm.	270 sq. mm.	330 sq. mm.	396 sq. mm.
6	pH after fermentation	5·4	5·0	5·1	5·2	5·1
	Antibiotic activity.	243 sq.mm.	396 sq. mm.	300 sq. mm.	363 sq. mm.	396 sq. mm.
7	pH after fermentation	5·4	5·0	5·2	6.0	5·4
	Antibiotic activity	216 sq. mm.	270 sq. mm.	270 sq. mm.	sq. mm.	243 sq. mm.

nesium sulphate 0·5 gm.; ferrous sulphate 0·01 gm.; potassium chloride 0·5 gm.; tap-water 1000 c.c.; pH 6·8.

The antibiotic activity developed after a given number of days, has been detrmined by measuring the area of clearance in square millimeters. The results are given in Table I.

The addition of bran extract was found to improve the growth of the mold, which was roughly proportional to the quantity of the supplement. It will be observed from the results that bran extract favours the formation of penicillin, the maximum being attained on the fifth and the sixth days. After this period there is a gradual fall in the antibiotic content. During these studies a sixty per cent. increase of penicillin has been obtained by the addition of the bran extract.

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T. N. RAMACHANDRA RAO.
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Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
March 28, 1946.

1. Moyer, A. J., and Coghill, R. D., *Chem. and Engin. News*, 1944, **22**, 588. 2. Clifton, C. E., *Science*, 1943, **98**, 69. 3. Cook, R. P., Tulloch, W. J., *et al.*, *Proc. Biochem. J.*, 1945, **39**, 23. 4. Holtmann, D. F., *J. Bact.*, 1945, **49**, 313. 5. Foster, S. W., Woodraff, H. B., and McDaniel, *J. Bact.*, 1943, **46**, 425. 6. Sreenivasa Rao, S., *Nature*, 1944, **154**, 83. 7. Knight, S. G., and Frazier, W. C., *Science*, 1945, **102**, 617. 8. Ramachandra Rao, T. N., Ram Mohan, R., and Sreenivasaya, M., *J. Sci. Ind. Res.*, 1945, **4**, 377.

CYTOCHEMICAL STUDIES OF AVITAMINOSIS IN TODDY YEAST

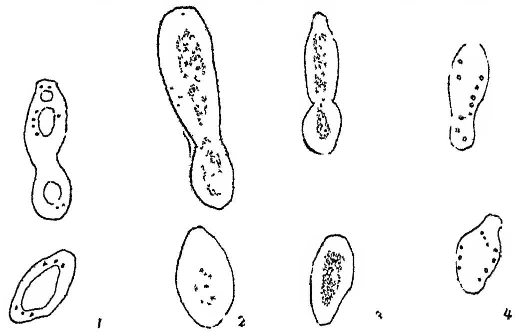
DURING studies of vitamin requirements of some yeasts, it was observed that lack of inositol modifies the gross physical structure of the yeast growth; the growth was "spongy" and granular. A microscopic examination of the cells revealed an appearance characteristically different from the cytological picture presented by the same yeast grown under similar conditions but with the full complement of vitamins including inositol.

A systematic study of the vitamin requirements of this toddy yeast (obtained from Ceylon) showed that niacin and inositol are the two vitamins which are indispensable for its growth. The organism has been grown in basal synthetic media with and without the vitamins. After 24 hours' incubation, the growth of the organisms was measured turbidometrically; cell counts also have been carried out. A microscopical examination of the cells has also been conducted (see Figs. 1–4). The results are given below:—

TABLE I

Medium	Turbidity, Absorption per-cent.	No. of cells Millions per c. c.
Basal medium + No Vitamins	9	1714
Basal medium + all Vitamins	30	13,248
Basal medium + all Vitamins except inositol	14	2184
Basal medium + all Vitamins except niacin	9	2400

It will be seen from the table that the organism offers possibilities of being used for the microbiological estimation of inositol and niacin. A study of the figures reveal that inositol



1 no vitamin; 2. all vitamins, 3. lacking inositol; 4. lacking niacin

deficiency appears to influence the formation of the cytoplasmic constituents while the lack of niacin is presumably connected with the development of the basophilic metachromatic granules and the nucleolar vacuole (?) of the cell.

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April 18, 1946.

"KAIO" AN IMPORTED BANANA VARIETY

A NEW variety of banana, 'Kaio', has been introduced in South India and it is being grown at the Banana Experimental Area of the Agricultural Research Institute, Coimbatore. This variety is a native of the Hawaiian Islands, and from the description of Pope,[1] who described it under its native environ, a true picture of its potentiality cannot be assessed. It was, therefore, thought best to observe the variety under South Indian conditions as regards its general performance and a study of this variety was undertaken by the author of this note at the College Orchards of the Agricultural Research Institute, Coimbatore, during the years 1942-1945. Only four plants were available for study and the details of performance of this variety are presented below in the form of a brief description:—

Plant.—About 10 feet in height, pseudostem about 24 inches in girth at base, tapering very little from base to crown; outer sheaths characteristically coloured light green with reddish shades, the tint extending to the petioles and the mid-ribs of the leaves: leaf-blade about 7 feet long with the greatest width being about 24 inches; petiole long, stout, margins coloured deep reddish brown and quite wide apart from each other; base of lamina unequal and the margins of the lamina coloured pink; total number of leaves produced per plant average 38. This variety is found to be a very shy sucker producing one when grown under Coimbatore conditions, the number of suckers produced varying from 1 to 4. This is a feature in contrast with the other varieties grown in South India. The plant takes about eleven months to put forth the inflorescence.

Inflorescence.—Pendant, length about 22 inches before the first bracts open; bracts light brown in colour; peduncle or stem slender, green, gracefully arched; flowers of two types, functionally staminate and pistillate ones, are met with as in the other varieties.

Bunch.—Compact with about 8 to 10 hands, each hand with about 10 to 12 fingers or fruits arranged almost at right angles to the main axis; medium bunch weighs about 35 lb. (among the plants studied the maximum weight of one bunch recorded was 50·5 lb. and it contained 102 fruits). The sterile axis of the fruiting bunch is naked, *i.e.*, the functionally staminate flowers are deciduous, and this axis ends in a small 'heart' or ovoid bud with light brown coloured bracts. The fruiting bunch takes about three months to attain full maturity from the time of flowering (Fig. 1).

Fruit.—About 6·5 inches long, 7 inches in girth at the mid-region, oblong to spindle shaped, almost straight, plumpy, 3 to 5 angled, sides inflated, angle ridges almost indistinct when fully ripened; basal end tapering into a short, stout, angular pedicel; apex very blunt and marked with a prominent scar where floral parts were formerly attached; skin medium to thin, leathery, deep lemon yellow in colour, peeling off easily from the pulp; pulp firm, slightly pinkish in colour; core distinct; taste and flavour as in 'Nendran', the Malabar Banana. This fruit may be consumed both as a fruit and as a vegetable.

FIG. 1

The present writer is not aware of the distribution of this variety in India, and he will be thankful to those who can acquaint him with their experience of this variety in localities other than Coimbatore.

In conclusion, he wishes to express his thanks to Sri K. C. Naik, Fruit Specialist, Madras, for the help and encouragement he had received from him during the course of this study.

University Botany Laboratory,
Triplicane P.O., K. S. VENKATARAMANI.

1. Pope, W. T., "Banana Culture in Hawaii," *Hawaii Agr. Expt. Sta. Bull.*, 1926, **55**.

ON THE EMBRYO-SAC OF *CLINTONIA*

IN 1911 R. W. Smith described the development of the female gametophyte of *Clintonia borealis*. According to this author, out of the four megaspore nuclei which are formed after the meiotic divisions in the megaspore mother-cell, the one situated towards the micropyle divides twice to form a four-nucleate embryo-sac; these four nuclei organise themselves as 2 synergids, 1 egg-cell and 1 polar nucleus. The chalazal three megaspore nuclei undergo prompt degeneration. It may also be noted that the megaspore nuclei are not separated by walls. This method of development is in complete agreement with the one described for *Œnothera* but for the presence of walls in the linear tetrad of megaspores. K. Schnarf (1929) has indeed classified the embryo-sac of *Clintonia borealis* as belonging to a modified form of the *Œnothera*-type. The original observations of Smith, however, have not received a whole-hearted approval from several morphologists like K. Schnarf, H. Stenar and

others; P. Maheshwari has recently (1937) tried to clarify the situation by suggesting an alternative explanation of Smith's original figures. This alternative course, according to his surmise, was most probably that of a *Fritillaria*-type, as he interpreted some of the figures of Smith as representing certain characteristic phases—"1 + 3 arrangement of megaspore nuclei" and "Secondary four-nucleate stage"—of this type of embryo-sac development.

F. H. Smith (1943) investigated the sequence of the development of the embryo-sac of *C. uniflora* and found that it corresponded with the observations of R. W. Smith for *C. borealis*. Very recently R. I. Walker (1944) has not only reinvestigated and confirmed F. H. Smith's observations for *C. uniflora* but has also studied two other species of the genus, *C. umbellulata* and *C. andrewsiana*, and has found the same type of development. These results have made it possible to note that there are no reasons to doubt the original observations of R. W. Smith on the embryo-sac of *C. borealis*. Its development reveals an unmistakable similarity to the monosporic tetranucleate embryo-sac of the type described for several members of the family Onagraceæ. As a natural consequence, the embryo-sac of *Clintonia* will have to be looked upon as belonging to the *Œnothera*-type but only with a slight modification in that the walls separating the megaspore nuclei are absent.

Basavangudi,
Bangalore, B. G. L. SWAMY.
March 20, 1946.

1. Maheshwari, P., *New. Phyt.*, 1937, **36**, 360–417. 2. Schnarf, K., *Embryologie der Angiospermen*, 1929. 3. Smith. F. H., *Bot. Gaz.*, 1943, **105**, 263–67. 4. Smith, R. W., *Ibid.*, 1911, **52**, 209–17. 5. Walker, R I., *Bull. Torrey Bot. Club.*, 1944, **71**, 529–35.

MODE OF TRANSMISSION OF THE BUNT OF RICE

BUNT [*Neovossia horrida* (Tak.) Padwick and Azmutullah Khan] of rice was, until recently, assumed to be an externally seed-borne disease. Recently Mundkur[1] has stated that the disease may be probably air-borne (floral infection), but he has adduced no experimental evidence to substantiate his assumption. Anderson[2] stated that he had found hyphæ in the stem tissues of bunted plants and Butler[3] has confirmed that finding but on what grounds these authors presumed that the mycelium was that of the bunt fungus is not very clear. In the Philippines Reyes,[4] as a result of pot and field experiments, came to the conclusion that rice bunt is systemic and transmitted through the spores adhering to the seed.

Experiments carried out by the author during the past few years have shown that this bunt is not seed-borne and that infection does not take place in the seedling stage. Examination of a large number of diseased ears has revealed that only a few grains, the number varying from two to six, are usually affected. The remaining grains are perfectly healthy. An ear in which all the grains are bunted has not so far been observed. Furthermore the bunted grains in an ear occur rather irregularly and do not conform to any ordered arrangements. The bunt is not ovaricolous but fructicolous and the grains themselves are either wholly or partially changed to a black powdery mass.

The irregular manner of occurrence of infected grains in the ear indicates that initial infection must have been external; only those grains in an ear being infected where the spores or sporidia carried by an external agency had settled down, each bunted grain representing a single, strictly local set of infection. It is manifest that the spores from the previous season lying about in the fields on the stubble or other paddy refuse or in the soil germinate in October-November with the advent of favourable conditions, producing a large number of sporidia. These sporidia, carried by the wind, settle on the ears in the anthesis or dough stage and the grains ultimately get attacked.

The above assumption was proved by experiments carried out at Sylhet during the year 1945 with successful results. Moore's[5] vacuum method of infecting the ears was used. Spores or sporidia were used for inoculation. Prior to inoculation the spores were in some cases soaked in distilled water for three to four days; the sporidia were obtained by germinating the spores in moist chambers. After inoculation the heads were covered with paper bags and labelled. Inoculations were made in October-November.

A large number of ears was inoculated. Inoculations with sporidia gave consistently better results and higher percentage of infection; in all 72 out of 97 inoculated ears showed infection. Inoculation with the spores, on the other hand, gave very poor results; only 4 out of 72 inoculated ears showed infection. It is probable that under natural conditions sporidia serve as inocula.

The author's thanks are due to Dr. B. B. Mundkur, Imperial Agricultural Research Institute, New Delhi, for helpful suggestions.

Plant Pathological Laboratory,
Sylhet, Assam, S. CHOWDHURY.
January 15, 1946.

1. Mundkur, B. B., *Indian J. Agri. Sci.*, 1945, **15**, 109 2. Anderson, A. P., *Bot. Gaz.*, 1899, **27**, 467 72. 3. Butler, E. J., *Pusa Agri. Res. Inst. Bul.*, 1913, **34**. 4. Reyes, G. M., *Philip. J. Agric.*, 1933, **4**, 241–70. 5 Moore, M. B., *Phytopath.*, 1936, **26**, 397–400.

ON A PROTOZOAN PARASITE, *MYXOBOLUS MRIGALAE* CHAKRAVARTY, FOUND INFESTING THE FRY OF *CIRRHINA MRIGALA* (HAM.)*

IN his "Studies on Myxosporidia from the fishes of Bengal", Chakravorty§ described *Myxobolus mrigalæ* infesting the scales of adult *Cirrhina mrigala*. During an inspection of the Kalighat Fish Fry Market at Calcutta, in October 1945, evidently healthy and normal fry of *Cirrhina mrigala* of an average length of two inches were found heavily infested with this parasite. The cysts, forming small white patches, were found all over the body except the head region. The infestation was less marked nearer the caudal end and the fins

were absolutely free from cysts. Some infected fry were preserved in 4 per cent. formalin and later hanging drop preparations were made for the study of spores.

As a result of the study of the material, Chakravorty's description requires emendation on the following points:—

(1) In most cases, the polar capsules are equal while only in a few cases they were found to be unequal as described by Chakravorty.

(2) The average size of spores was found to be $8 \cdot 56\,\mu \times 8 \cdot 56\,\mu$ and of capsules $4 \cdot 28\,\mu \times 3 \cdot 21\,\mu$. These dimensions differ slightly from those given by Chakravorty but the variation is not of specific importance.

The main object in writing this note is to bring to the notice of fish culturists in Bengal the desirability of disinfecting the fry before planting them in rearing tanks. This can be done by a bath in Condy's Fluid (½ grain by weight of potassium permanganate per gallon of water) or a weak solution of common salt (0·2 per cent. solution). Besides eradicating Myxosporidian infection, this treatment will kill fungus and the Fish Louse *Argulus* which sometimes cause heavy mortality in tanks, stocked with carp.

I am grateful to Mr. Mukundamurari Chakravorty for examining the material and confirming my identification.

Directorate of Fisheries, Bengal,
13, Ballygunge Circular Road,
Calcutta, H. L. SARKAR.
February 25, 1946.

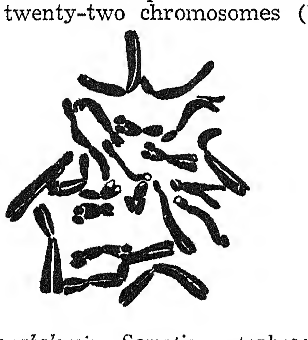
* Published with permission of the Director of Fisheries, Bengal.

§ Chakravorty, M., *Archiv. fur Protistenkunde*, 1939, **92**, 173.

THE SOMATIC AND MEIOTIC CHROMOSOMES OF *COMMELINA BENGHALENSIS* LINN.

DARLINGTON (1929) in his studies on the Tradescantieæ reports that the diploid number of chromosomes in *Commelina benghalensis* is probably sixty-eight. Anderson and Sax (1936), however, oberve that there are about six bivalents and thirty-six univalents in the pollen mother-cells. The forms stdied by them show complete pollen sterility.

Studies in the root-tip cells revealed the presence of twenty-two chromosomes (Fig. 1).



Commelina benghalensis. Somatic metaphase in root tip cell showing twenty-two chromosomss (× 3000).

The chromosomes are somewhat slender and elongated. The primary constrictions are mostly median or submedian but subterminal constrictions are quite frequent. Darlington also observes that chromosomes with median constrictions are more numerous.

For the study of meiotic chromosomes flower buds of both underground and aerial branches were examined. No difference in the meiotic process was observed. Eleven bivalents are clearly seen in the diplotene, diakinesis and metaphase stages and eleven univalents can be counted in either pole at anaphase. The pollen grains appear normal and germinate well in 2 per cent. agar-sucrose solution. Furthermore, normal setting has been observed in both the underground as well as the aerial branches and the seeds show their characteristic worty nature.

Thus it appears that there is no indication of any pollen sterility in the particular form of the species studied. The writer is not aware of the sources of materials investigated by Darlington (1929) and Anderson and Sax (1936), but it appears that the form studied here is absolutely different from those of the said authors.

The writer wishes to express his thanks to Dr. I. Banerji for his interest and help.

JAYANTA KUMAR GANGULY.
Department of Botany,
Calcutta University,
February 20, 1946.

1. Anderson, E., and Sax, K., "A cytological monograph of the American species of Ttadescantia," *Bot. Gaz.*, 1936, **37**, 433–476. 2. Darlington C. D., "Chromosome behaviour and structural hybridity in the Tradescantieæ," *Jour. Genet.*, 1929, **21**, 207–288.

A RECORD OF THE LEECH *GLOSSIPHONIA RETICULATA* KABURAKI, TOGETHER WITH A NOTE ON ITS PARENTAL CARE

SOMETIME back, while dissecting a fresh-water mussel (*Lamellidens marinalis*) in our laboratory, I came across a small leech under its mantle-cover. This leech was identified to be a species of *Glossiphonia*. The only species of *Glossiphonia* parasitic on Lamellidens, so far recorded from India is *G. reticulata* Kaburaki. Now the leech found by me is identical with Kaburaki's[1] description of *G. reticulata*, except that its colour is olive-green and in the living condition its length is 12 mm. and breadth 3·5 mm. Kaburaki mentions that there is only a single specimen of this species in the Indian Museum and this was collected by Dr. B. Prashad from Jullardar, Punjab. Harding and Moore[2] describe the species after Kaburaki's original description but mention *Anodonta* to be its host. So my specimen forms the second record of the species from India and the first from Bengal.

Its parental care was found to be most remarkable. If it had laid eggs within the mussel they might have been carried away by the food currents constantly set in motion by the mussel, and so to secure these eggs from all possible danger the leech takes the eggs in a

shallow groove formed on ventral surface by slight infolding of the lateral margins of the body, at about one-third the distance from the oral end. It carries the brood wherever it goes. The size of the groove is not constant but varies every now and then as the leech lengthens and shortens its body, but at no time does the groove disappear, and the embryos are lodged in this groove and at no other part of the body. Young ones even after hatching continue to cling to mother's fold (Fig. 1).

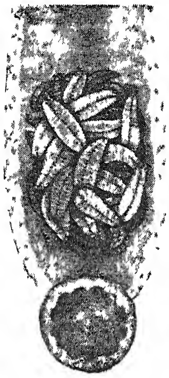


FIG. 1.—*Glossiphonia reticulata* Kaburaki; ventral view—showing the young leeches in the groove.

After examination of the leech under a hand lens I transferred it to a glass vial filled with tap water. At that time (December 16, 1945) I could not find any bodies sticking to the leech. After five days (December 21, 1945) when I was refilling the vial with fresh water, my attention was drawn to the ventral aspect of the leech where several minute globular eggs were adhering together with mucous secreted by the leech. I teased the leech with a needle, it moved in the typical fashion without displacing the eggs. I examined one of the eggs under the microscope. It was at an advanced stage of development which showed a slow circular motion. I gave a feed to the leech by pricking my finger and applying the leech to the cut surface. I carried on observation day to day changing the water of the vial daily. After a lapse of 20 days (January 10, 1946) I found the eggs hatched and the number of juvenile leeches noted were 37. These leeches when disturbed and forced to leave the parent swam back again to their mother's fold. What the young ones ate I cannot say. It is possible that freshly hatched ones can live without food for sometime until the proper host is seized upon. The mother which was once given a feed upon my blood was also deprived of food under captivity while kept in the vial of water, and yet remained alive.

The brood on examination on the 10th January 1946, showed fairly long young ones (measuring 2·5 mm. in length on the average) and they were leaving the parent's fold. I am now trying to infect fresh mussels with these young ones.

I should like to express my sincere thanks to Mr. Biswamoy Biswas for his kind help in connection with this work. The accompanying diagram has been drawn by Mr. U. Parui, for which I am grateful to him.

Zoological Laboratory, SIVATOSH MOOKERJEE.
University College of Science,
35, Ballygunge Circular Road,
Calcutta,
January 12, 1946.

1. Kaburaki, "Notes on some leeches in the collection of the Indian Museum," *Rec. Ind. Mus.*, 1921, **22**, 700-01. 2. Harding and Moore, *Fauna of British India—Hirudinea*, 1927, p. 65.

WHITE-FLOWERED PLANT OF *URENA LOBATA* LINN.—A NEW OBSERVATION

Urena lobata Linn. is distributed 'throughout the hotter parts of India' and in the tropics of both hemispheres[2] in general. 'In Bengal it is found as a weed of waste places and roadsides.'[3] During an excursion in April 1945, the writer came across a perfectly white-flowered plant similar in all other characters to *Urena lobata* L., growing wild among other plants beside a rivulet in the Dacca city (E. Bengal).

The flower colour of *U. lobata* L., has been described by Hooker[2] as pink, by Kirtikar and Basu[5] and by Fyson[6] as pink with darker centre. Merrill[4] in re-describing Rumphii's[1] *Lappago amboinica* as *U. lobata* L., states that the flowers are deeply purple in colour. This would suggest that flower colour of *U. lobata* L., may be either pink or purple. Reference to authorities of the Royal Botanic Gardens, Calcutta, has confirmed the identification of the plant with white flowers to be *U. lobata* L., and that a white-flowered type has not been reported before. In view of these facts it is suggested that in future description of *U. lobata L.*, the flower colour should be corrected to include "white or pink", instead of pink only as at present.

Department of Agriculture,
Anderson House,
Alipore,
Calcutta, MURARI PROSAD GUHA.
August 8, 1945.

1. Rumphii, G. E., *Herbarium Amboinense*, 1750, vi, **59**, t. 25. f. 2. 2. Hooker, J. D., *The Flora af British India*, 1875, **1**, 322. 3. Prain, D., *Bengal Plants*, 1903, **1**, 261. 4. Merrill, E. D., *Interprt. Rumph. Herb. Amb.*, 1917, 354, 357. 5. Kirtikar, K. R., and Basu, B. D., *Indian Medicinal Plants*, 1918, **1**, 177, t 125. 6. Fyson, P. F., *Fl. Nilgiri and Pulney Hill-tops*, 1928, **3**, **2**, t. 222.

REVIEWS

A Food Plan for India. With a Foreword by Professor A. V. Hill. (Oxford University Press. Issued under the auspices of the Royal Institute of International Affairs), 1945. Pp. 62. Price Rs. 2.

It is somewhat strange that the authors of this well-thought-out and carefully documented book, so topical at the moment with a threatened famine on a gigantic scale, should prefer to remain anonymous. Nonetheless, the book represents a carefully prepared food plan for a concerted action, employing all the resources of science and technology and the fullest co-operation of all men of good will, to meet the needs of a rapidly expanding population for more and better food. The plan is evolved by a private group of authorities, and derives directly from Prof. Hill's compelling analysis of the situation. It is, in essence, a short-term one, covering only seven years, and as Prof. Hill has observed in the Foreword, the authors "have concentrated on working out possible machinery by which a few simple, practical measures, known from experience to be capable of giving substantial results, could be put into effect on such a scale as to increase the overall food production in India by between one-quarter and one-half in seven years". It has been considered on a quantitative basis and the financial implications thereof worked out tentatively. The plan "outlines concrete proposals by which the extra 14 million annual tons of food can be obtained, which with a 50 million increase in population and with rising standards, will be required by 1953". This target, if achieved, will ensure sufficient margin of safety. The plan is practical in every sense and affords employment to a decent number of demobilised men. The authors are certainly modest when they observe that their solution to problem is not unique, but is one, they are convinced, will work.

The authors of the plan take into account the dangers implicit in the present population and food trends in India and the fact that the accelerating increase of India's population would stultify all planning for a better way of life unless a supreme effort is economically directed to the basic problem of food production. Many measures are needed to step up food production but the authors have concentrated their attention on five important factors, *viz.*, (1) use of fertilisers and manures, (2) improvement of water supplies and erosion control, (3) use of improved varieties of seed, (4) control of seed-borne disease and of stored-grain pests, and (5) malaria control. The present low crop yields in India come in for a good deal of attention, and measures are suggested to overcome it, in the light of experience gained in other countries. The improvement in the quality of food levels in India and distribution of foodstuffs in an efficient manner are also dealt with in a masterly way. The role of fish in Indian dietaries and development of fisheries are treated in the form of an Appendix. References to literature are done not in the conventional manner of mere citations but in a manner calculated to add greatly to the usefulness of the book. An Index is provided for.

In short, the book is an authoritative and expert document and its publication now is extremely opportune as the spectre of famine is looming large. Those interested in augmenting India's food resources—a dire need indeed—will find the book extremely useful and practical.

S. RANGANATHAN.

Famine Rationing and Food Policy in Cochin By K. G. Sivaswami; and **Medical Surveys**, By Lt.-Col. T. S. Shastry and Dr. J. A. Bhat. (Servindia Kerala Relief Centre, Royapettah, Madras), February 1946. Pp. x + 77 + 35, with 11 illustrations. Price Rs. 3.

This book by the Servindia Kerala Relief Centre stands out in refreshing contrast to its companion volumes dealing with Travancore, both in its get-up and in the presentation of the material.

The State of Cochin normally imported in pre-war times about three-fifths of her rice requirements, mainly from Burma. Its stoppage presented a really formidable problem, and the manner in which Cochin tackled the famine is admirably set forth in the book; both procurement and distribution were directly undertaken by the State and the results achieved were, in the author's opinion, far more efficient than in many parts of South India confronted with more or less a similar situation. Besides selling grains at subsidised prices, the State undertook mid-day feeding of school children, running of restaurants for supply of meals at cost price, distribution of milk to children, etc. In spite of best of efforts on the part of the authorities, the resources, till October 1944, were hardly enough to supply more than 5 or 6 ounces of rice per adult per day. The Government were then faced with the grim realisation of the fact that this quantity could not fill the stomach unless supplemented by tapioca. Protein foods, such as fish, coconut and pulses could not be had in sufficient quantities by the poorer classes to improve their rice-*cum*-tapioca diet. Ample evidence is presented of the devastating effects on the population of such an inadequate and ill-balanced diet. Deaths from severe malnutrition, dysentery and diarrhœa, anæmia, malaria, œdema, etc., showed a tremendous increase during this period of food shortage.

The food policy of the State is discussed in relation to what is urgently needed to improve the situation. The author has made useful and practical suggestions for a short-term programme which is essentially intended to prevent further deterioration in the health of the more vulnerable groups, children and nursing and expectant mothers. Measures for a long-range policy are also outlined. Special emphasis is laid on hand-pounded rice as being more

in harmony with rural economy than parboiled milled rice.

The illustrations are well reproduced and enable the reader to gain a clear insight into the appalling famine conditions. Many useful and informative appendices are to be found, including a short note on the conditions of farm tenancy in the Cochin State. One only wishes that the page-numbering of the appendices was done in a different manner: one also wishes that the expression "calcium extracts" in p.v. is substituted by a less jarring one. These are only minor blemishes in an otherwise able document.

S. RANGANATHAN.

An Introduction to the Theory and Design of Electric Wave Filters. By F. Scowen, B.SC., A.Inst.P., with a Foreword by A. J. Gill, M.I.E.E., Fellow I.R.E. (Chapman & Hall Ltd., London, W.C. 2), 1945. Pp. 164 + 60 figs. Price 15 *sh.* net.

This excellent book is meant to help the engineer to design and construct filters by means of templates, nomographs and charts, avoiding long and laborious calculations.

It consists of 19 sections, the first two of which relate to important mathematical and electrical subjects considered essential for filter design. Sections 3 to 16 relate to design of low-pass, high-pass, band-pass and band-stop filters of the ladder type actually used in communication systems. Section 14 dealing with the various calculations by means of templates developed by British P.O. Engineering Department on the lines of Laurent and Rumpelt deserves special mention. The parallel connection of filters which is widely used in carrier telephone systems receives considerable attention in Section 15. Section 16 has been devoted to the examples of ladder type filter design and forms a very interesting reading for an engineer who intends to design his own filter.

The usefulness of the work has been considerably increased by the inclusion of Section 17 dealing with the lattice networks. The lattice type filter theory with application to crystal filters has been presented. Section 18 relates to certain practical considerations in the filter construction.

The book is highly recommended for use by the Indian Posts & Telegraphs Department, the All-India Radio and other communication administrations and concerns where the engineers have to design and construct a large number of filters for their systems.

S. P. CHAKRAVARTI.

1. **The Decimal and Colon Classifications.** (A Summary and a Comparison.) Foreword by S. R. Ranganathan. (Poona: N. K. Publishing House), 1945. Pp. xvi + 147. Rs. 2-4-0.
2. **Classification of Marathi Literature.** By S. R. Ranganathan. (Poona: N. K. Publishing House), 1945. Pp. 44. Rs. 1-4-0.

The two books, first two accessions to the K. Taraporevala Series in Library Science, are devoted to one of the most important subjects of library classification. Any scheme of library classification is indissolubly bound up with the classification of knowledge, and as such should be not only all-embracing but *par excellence* flexible and elastic. On these premises the first book proceeds to describe and compare the Dewey, the generally accepted, and the Colon, the young and now growing, systems of classification. We cannot enter into the details of the controversy but can only refer to the soundness of the author's arguments which would hold an easy appeal to anyone who had had difficulties with the Dewey scheme in classifying his book-store. The way in which the book is written makes it perhaps the most lucid exposition yet made of the Colon classification. To libraries and especially special libraries which may have adopted their own arbitrary schemes of classification, it is an invitation to "Colonization".

The second booklet is by the father of the Colon classification. It shows the richness of the Marathi literature with its 4,000 authors, the inadequacy of the Dewey to deal with it, and the resourcefulness of the Colon language in supplying Colon numbers 'co-extensive with each author, each work of his, and each type of work on him'. This is illustrated with selected examples. When we remember that the author is not one of the Marathi-speaking public, our admiration increases all the more for his probing scholarship. The only uneasiness the reviewer occasionally felt was at the transcription of some of the Marathi phrases. On the whole, the small monograph embodies a study of the successful application of the C. C. to a special field in *belles-lettres*, and it is to be hoped that it will be the precursor of further monographs devoted to special fields in arts and sciences.

G. T. K.

An Introduction to the Taxonomy and Nomenclature of Fungi. By C. R. Bisley, M.A., Ph.D. (Imperial Mycological Institute, Kew, Surrey), 1945. Pp. viii + 117. Price 5 *sh.* or $1.25.

This slim volume is an attempt to educate and help the "Amateur" to find an easy road in his identification of Fungi. The author has chosen a non-professional mycologist and has tried to help and guide him to further the useful addition of valuable material on fungi.

The book mainly falls into two broad groups. The first is "Taxonomy" and the second the "Nomenclature of Fungi". At the very beginning, a chapter is addressed to the "Amateur", but very little information is made available except telling him to enlarge his views by attending lectures.

In the succeeding chapters under the headings Equipment, Collecting, etc., the information though adequate could easily have been made more useful by including typical life-histories of group representations at least.

The second portion of the book is entirely devoted to nomenclature whose inclusion as the author points out, is determined by the fact that "the International Rules of Botanical Nomenclature are not redily available at present."

The book is written with an eye although on the "Amateur" mycologist who does not get a salary for it. It is doubtful if with the rapid increase in the great number of technical workers in the field, and the decreasing number of such "Amateurs", the book will find increasing use. The book serves a useful but limited purpose.

T. N. R.

SCIENCE NOTES AND NEWS

Prof. P. C. Mahalanobis has been appointed a member of the Statistical Commission established by the Economic and Social Council of the United Nations Organisation. He will attend the first session of the Commission to be held at New York, beginning from April 29.

Dr. V. K. R. V. Rao, one of the Advisers to the Indian Food Delegation, has been appointed to a Special Committee of Economists by the United Nations Food and Agricultural Organisation.

The Central Government, it is learnt, is arranging to start a Central Rice Research Institute. Mr. K. Ramiah, M.B.E., formerly Geneticist-Botanist, Institute of Plant Industry, Indore, has been appointed Special Officer in this connection.

The Syndicate of the Andhra University has announced that on the recommendation of the Board of Examiners consisting of Prof. C. K. Ingold, F.R.S., Prof. G. B. B. H. Sutherland and Dr. F. G. Donnan, F.R.S., Mr. K. Venkateswarlu, M.Sc., has been declared qualified for the Degree of Doctor of Science (D.Sc.) for his thesis entitled "Intensity and Related Problems in Raman Effect".

The Senate of the Benares Hindu University, at its meeting held on the 31st March 1946, decided to confer the degree of D.Sc. in Botany (Algology) upon Mr. Rama Nagina Singh, M.Sc., on the unanimous recommendation of the Board of Examiners, consisting of Professor F. E. Fritsch, D.Sc., F.L.S., F.R.S., University Professor of Botany, University of London (Queen Mary College), and a member of the Council of the Royal Society, London, Professor W. H. Pearsall, D.Sc., F.R.S., University Professor of Botany, University of London (University College), and Professor Yajnavalkya Bharadwaja, M.Sc., Ph.D. (London), F.L.S., F.N.I., University Professor of Botany, Benares Hindu University. Mr. Singh submitted a thesis, entitled "Studies on Indian Algæ".

Kanai Lal Mendal, Professor of Chemistry, City College, Calcutta, has secured the D.Sc. degree of the Calcutta University for his researches in pure chemistry. Mr. Mandal is a first class M.Sc. and is known to the public for his popular scientific writings.

An industrial plant and machinery (heavy) Panel has been set up by the Government of India with a view to examining the possibilities of the manufacture in India of textile, sugar, paper, mining, cement, chemical and other machinery. To assist the Panel, the services of Messrs. Ford Bacon and Davis, a leading American firm of engineers, have been obtained.

The U.S. Government is planning to send a special agricultural mission to India similar to a group now operating in the Middle East. The mission will assist in mapping India's long-range programme for increasing its food supplies.

The following students of the Imperial Agricultural Research Institute, New Delhi, have been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after completion in September 1945 of their two-year post-graduate course and the acceptance by the Institute Council of the thesis submitted by them:—

Agricultural Botany and Plant Breeding: Prem Shankar Parsai, B.Sc. (Agri.) (Nagpur); Malik Hukam Chand, B.Sc. (Agri.) (Punjab); Mohd. Jamil Khan, M.Sc. (Aligarh); *Agricultural Chemistry and Soil Science*: B. R. N. Iyengar, B.Sc. (Mysore), B.Sc. (Agri.) (Poona); J. K. Jagtiani, B.Sc. (Agri.) (Poona); *Mycology and Plant Pathology*: M. S. Pavgi, M.Sc. (Benares); G. C. Dacosta, B.Sc. (Agri.); K. R. Chowdhury, B.Sc. (Calcutta); *Sugarcane Breeding*: Ghulam Yazani, B.Sc. (Ag.); Jagannath Hota, B.Sc. (Ag.) (Nagpur).

In our review of the work on Pyrethrum done in the Central Research Institute, Trivandrum, appearing in the "Notes and News" section of the March issue of *Current Science*, the pyrethrin content of the flowers has been stated as 0·5 per cent., whereas it is really 1·2 per cent. A more recent report from the Secretary, Council of Research, University of Travancore, says, "an even higher content of pyrethrins (1·3 to 1·4 per cent.) has been obtained."

ERRATA

Vol. 14, No. 1, January 1946:

Page 10, column 2, para 1, lines 10-11 from top: *delete* the statement "but neither of them ..... sulphur deficiency".

Page 10, column 2, para 3, line 21 from bottom: *for* "ammonium sulphate" *read* "ammonium phosphate".

The cost of printing the following articles appearing in this issue has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India:—

1. Vegetable Ghee (p. 94).
2. Sunspots (p. 95).
3. D.D.T. 666 and Insect Pests of Stored Grains (p. 98).
4. A Museum of Evolution (p. 99).
5. War and Indian Mineral Industry (p. 101).
6. Shellac Adhesives and Cements (p. 102).

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CURRENT SCIENCE

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COMMONWEALTH SCIENTIFIC CONFERENCE, 1946

IN the middle of next month, London will have occasion to welcome representative scientists from every part of the British Commonwealth; the Conference of Commonwealth Scientists, which has been arranged in close consultation of the Royal Society, is scheduled to commence its deliberations in the middle of June, and is expected to continue its sittings until the end of July. The official conference of the Commonwealth Government Delegates, proposed to be held in London, will be immediately preceded by the Royal Society Conference. The two conferences are intended to be complementary; the Royal Society Conference will, in general, deal with the scientific subjects under discussion while the official conference will consider also problems pertaining to matters of an administrative and organisational character.

The war-time experience of inter-imperial and transcontinental scientific collaboration, which shortened the war and led to its victorious end, is now to be consolidated and fully mobilised in the work of rehabilitation and reconstruction which faces every part of the globe; in the achievement of this stupendous task, the aid of science will have to be invoked in a far greater measure. The aftermath of the war has been widespread and devastating; the world is threatened with spectre of famine and pestilence with all the ugly consequences of malnutrition, disease and death. Apart from taking certain palliative measures to alleviate the immediate suffering, a long-range plan of concerted action is essential for removing all causes which lead to a frequent recrudescence of these misfortunes. In other words, the problems of crop production, nutrition and public health, industrial prosperity and national security, have to be considered and solved at the international level, if results of any value of permanence are to be secured in a reasonably short period. If all the nations could help to pool together their scientific knowledge and technical experience the speed of reconstruction could be augmented; and the Commonwealth Scientific Conference which has been organised is a step which will promote the cause of reconstruction. It is a matter of supreme satisfaction that a delegation of distinguished scientists from India is participating in the Commonwealth Conference.

The subjects which will come up for discussion have a common interest to all the participating units of the Commonwealth. Soil erosion and conservation, the taming of rivers and irrigation, conservation and exploitation of forests and fisheries, nutrition and public health, improvements of plants and animals, industrial utilisation of the mineral resources and natural products, harnessing the fuel and power resources—these are problems of universal importance; they have been tackled more or less successfully by most of the countries depending upon the availability of scientific knowledge and technical proficiency. A discussion of these problems and their attempted solutions by different groups of scientists at a common table, will not fail not only to reveal many points of common interest and but also lead to improved and co-operative methods of solving these problems in a manner which might ultimately prove more efficient and economical.

The Conference will naturally devise the administrative machinery through which the necessary collaboration could be secured. The mutual establishment of liaison officers in all parts of the Commonwealth and also in some of the advanced countries will serve to set in motion this great experiment in collaboration. Exchange of technical information, movement of technical personnel from one part of the Commonwealth to another, training of technical experts, are some of the outstanding problems which will no doubt be discussed at the forthcoming Conference.

The Conference constitutes an enterprising and commendable experiment in inter-Commonwealth collaboration for solving problems of common interest, and if successful, the experiment will no doubt be extended on an

international scale. It contains the seed through which nations will realise the value of collaborative effort in the common cause of establishing the four freedoms for which the second global war has been fought. Men of goodwill the world over will watch the proceedings of the Conference with the keenest interest and wish it an unqualified success.

FAZLI-OMAR RESEARCH INSTITUTE, QADIAN

On the occasion of the Opening Ceremony of the Fazli-Omar Research Institute, Qadian, on the 19th April 1946, Dr. Sir Shanti Swarup Bhatnagar, O.B.E., F.R.S., Director, Scientific and Industrial Research, Government of India, declared :—

"When the Hon'ble Justice Sir Zafarullah Khan spoke to me in Delhi of the step which the Ahmadiyya community, under the inspiration of Hazrat Khalifatul Masih, had taken in providing funds for the Fazli-Omar Research Institute, I felt deeply touched. It appeared to me as a symbol of the acceptance of the method of science by a great religious leader. Sir Zafarullah humourously remarked that in choosing me for this honour, he had specially in mind the spiritual elevation of an old friend whom science had cut off completely from religion. I readily accepted the invitation as I did not wish to miss the opportunity of seeing this forward little town. I also very thoroughly appreciate the honour which this ceremony has offered me of coming into contact with Hazrat Khalifatul Masih. This is a privilege which I had cherished for a long time and its fulfilment to-day will never be forgotten by me. It will be a source of inspiration to me in my own arduous task of developing scientific and industrial research in India.

In selecting Dr. Abdul Ahad as the first Director of the Fazli-Omar Research Institute, your choice has fallen on one who combines in him the zeal for scientific research with great devotion to religion. I am much impressed by his vast knowledge of contemporary science. I am particularly happy that he has quoted in his speech the last words in a recent broadcast of mine on the subject of the Scientists' Utopia: "It looks certain that in the utopia of scientists God and Science will be brought into a fertile union in which the idea of God instead of being diluted will be enriched." This is my conviction and also the belief of a great many top-rank scientists of the world. The scientist to-day is not the hot-headed, blasphemous and conceited fellow which he used to be sometime ago. Physics has merged into metaphysics. The pride of the scientist has been humbled to such an extent that he no longer contends that science can explain even all that meets the eye. Amongst the prominent scientific workers of the world one would hardly find one who may be considered as a complete athiest. Numerous proofs that both science and religion are devotees of truth and righteousness can be quoted. The fact, Sir, that you, the religious head of a powerful community, have decided to make the Fazli-Omar Research Institute, a part of education of your programme of the religious development of your people, is nothing else but an indication of the direction in which the wind is blowing. Religious leaders no longer look upon science as antagonistic to their creeds. Such a unification of religion and science and such contacts between religion and science as your Institute will establish, are no doubt to be very much appreciated. The spirit of tolerance and forbearance gets developed not by remaining aloof but by intimate contacts and social mixing and I, therefore, wish this Institute a long life of great usefulness.

Religion has sought in all ages to unite people and to bring them in tune with the spiritual side of the Universe. It has been established, however, that the physical well-being of man is important for even the development of his soul and mind and it has, therefore, been the policy of religious leaders lately to see that their followers have a better and higher standard of living. Nothing can raise the standard of living of people more than science and education and I have no doubt that the future and present generations of Qadian will remember with gratitude the philanthropists and workers associated with the founding of this Institute of which you have asked me to perform the inaugural ceremony to-day.

I hope the scope of this Institute will be broad enough and that it will include in its activities all those branches of learning which may have a direct bearing on the economic well-being of the people of this town and incidentally of the whole country. Subjects such as nutrition can be tackled by you with great advantage and the nearness of such industrial centres as Sialkot and Amritsar will give you ample opportunities of attracting industrial research of local interest. I must, however, warn you that research institutes are very expensive hobbies and that unless sufficient funds are at your disposal, your activities are likely to suffer. I hope that your community and the local and Central Governments and the Industry will come to your aid. To bring into being such an institution and then not to provide sufficient funds is like the underfeeding of a sturdy baby or the treatment of a patient suffering from malaria with insufficient quinine.

Your Institute is perhaps the second of its kind in India. I think the first one, if I am not mistaken, is the Technical Institute at Dyal Bagh in Agra which owes its origin to the far-sightedness of the late Sir Anand Swarup, one of the leaders of the Radha Swami Movement. That Institute has done yeoman service to the cause of technical education and industrial development in India. I do hope and pray that your efforts may result even in greater achievement.

There are two things which I particularly wish to emphasise on this occasion. Firstly, that no applied research can flourish if isolated from pure research. The huge physical body of applied research is kept alive and fit by a constant supply of new blood in the shape of fundamental research of a pure character. Let

not the enthusiasm of those interested in immediate results of a purely utilitarian character carry you away from the path of your right duty to science. India needs both pure and applied research and you should never deviate from this happy combination. Applied research may be compared to the social urge of building mosques and temples, but what use is a mosque unless the individuals and masses are imbued with the true spirit of prayer? Pure research supplies the urge for new developments and new fields of applications and it should not be allowed to be neglected, even though we might insist upon greater expenditures being allotted to applied work.

The second thing which I consider necessary is the proper education of the scientist. In America the emphasis on humanities had decreased to such an extent that the much dreaded monster-scientist was beginning to be envisaged. Fortunately, the Americans realised that the labour-saving devices of science will soon give so much leisure to man that his brain will become a devil's workshop and, therefore, they have begun to lay greater emphasis on the compulsory introduction of courses of studies in humanity in the scientists' and engineers' curricula. You are in a fortunate position because you will always be in surroundings largely dominated by religious and cultural atmospheres. This will prevent you from developing the purely utilitarian type of mind which the applied science may tend to make you. But it may be that your success in applied science may create so much wealth that it may blind you to the study of humanities. This you will have to take special steps to prevent.

I have no doubt that the kindly and humane spirit of Hazrat Khalifatul Masih will long guide you and that this Institute will grow into a mighty organisation for the good of humanity. With these few words I have great pleasure in declaring the Fazli-Omar Research Institute open. I wish it God-speed. May it result in the happy blending of science and religion and thus contribute to the forces which are tending to unite us all into One World."

BIAS IN THE USE OF SMALL-SIZE PLOTS IN SAMPLE SURVEYS FOR YIELD

By P. V. SUKHATME, Ph.D., D.Sc. (Lond.)

(Statistical Adviser, Imperial Council of Agricultural Research, New Delhi)

SAMPLE surveys for yield of cotton, wheat and paddy, conducted in recent years by the Indian Central Cotton Committee and the Imperial Council of Agricultural Research in the various provinces in India have been carried out on plots of large size, varying from one-tenth to one hundred and sixtieth of an acre.[1,2] The plots are marked with the help of pegs and chains and the produce is harvested with the help of labour specially employed for the purpose. In contrast the plot size used by Hubback in experiments on paddy in Bihar (1923-25), by Mahalanobis in experiments on wheat and gram in Bihar (1943-44) and by workers in England and U.S.A. is very small, of the order of $\frac{1}{4,000}$th of an acre.[3,4,5,6] The plots are marked with the help of a rigid or a semi-rigid sampling frame and the produce is gathered by the experimenter himself without the help of paid labour. In view of this great difference in the methods, an investigation was carried out in the district of Moradabad (U.P.), area 2,238 sq. miles, for comparing different-size plots.

2. Moradabad is divided into six tehsils of which all, except one, have an appreciable area under both irrigated and unirrigated wheat. The plan of sampling consisted in selecting eight random villages from each tehsil, four for experiments on irrigated wheat and four for experiments on unirrigated wheat, except in one tehsil, where all the eight villages were selected for experiments on unirrigated wheat. Sampling was done separately for irrigated and unirrigated wheat. In each selected village two wheat-growing fields were selected at random and in each selected field eight plots were marked at random: (*a*) two equilateral triangular plots of side 33 feet, subdivided into three strips by means of two lines drawn parallel to the base at distances of 8¼ feet and 16½ feet from the vertex along the sides, (*b*) three circular plots of radius 2 feet each and (*c*) three circular plots of radius 3 feet each. The two triangular plots of side 33 feet were marked with the help of chains and pegs. The circular plots were marked with the help of a specially devised apparatus consisting of a peg, a rotating steel tape and a plumb-line. The investigation was carried out by the staff of the Department of Revenue posted in the district, who ordinarily are required to carry out these experiments in the Province under the existing official orders. The entire work was carried out under the close supervision of the technical staff of the Statistical Section of the Council.

3. Out of a total of 768 plots proposed to be harvested under the scheme, 742 were harvested. The results are shown in the statement attached separately for irrigated and unirrigated wheat. It will be seen that small-size plots give biased estimates, but the magnitude of bias diminishes with increase in the size of plot. The results are consistent both for irrigated and unirrigated wheat. They show that small plots under 30 square feet result in serious over-estimation of yield, but even plots of 118 square feet are not free from bias. The differences in the yield estimates of plots other than those of approximately the same size are found to be statistically significant. The results are found to be similar in all the six tehsils in which experiments were carried out.

4. Yates has previously reported the existence of bias from the use of small-size plots.[7] He compares the results of experiments with a circular hoop of 10 square feet in area with those of sample plots of one-twentieth of an acre in size and the field as a whole, and finds

TABLE I

Average yield in pounds per acre with percentage over-estimation for plots of different sizes

Shape of plot	Size of plot in sq. ft.	Irrigated wheat			Unirrigated wheat		
		No. of plots	Average yield in pounds per acre	Percentage over-estimation	No. of plots	Average yield in pounds per acae	Percentage over-estimation
Equilateral triangle,							
Side 33′	471·55	78	831·1		107	539·0	
Side 16½′	117·89	78	870·6	4·8	107	598·2	11·0
Side 8¼′	29·47	78	961·9	15·7	107	664·9	23·4
Circle,							
Radius 3′	28·29	117	954·5	14·9	163	618·8	14·8
Radius 2′	12·57	117	1183·3	42·4	161	767·7	49·1

a very considerable bias in the use of circular hoops. The bulk of the bias, according to him, is due to the tendency to cast the hoop on the good parts of the crop.

5. In this investigation, the bias seems to be due to the tendency on the part of workers to include border plants inside the plot. The contribution of the border plants to the harvested produce is appreciable when the plot size is small, and is the main cause of the observed bias. The decision to include (or exclude) the border plants inside the sample area is particularly difficult in the case of cereals where the plants consist of several tillers, and necessarily depends on the tendency of the workers. With increase in the size of the plot, the contribution of the border plants decrease to have any appreciable influence on the estimates of yield.

6. An appropriate test of bias would have been to compare the results of different sizes of plots with those obtained from harvesting the whole field. It was not, however, found feasible to harvest the whole field in this investigation. A separate investigation was, therefore, conducted in Madras for comparing the results of large plot size (one-twentieth of an acre) with those derived from harvesting the whole field. The average estimated yields from the plot and from the field as a whole came to 1,477 and 1,447 lbs., respectively as against the standard error of 153 lbs. of the difference between the two and show that large plots are free from border bias.

7. The results of the investigation show that in the unevenly sown crops in India and possibly also in U.S.A. and England, the use of small-size plots such as are marked by rigid or semi-rigid sampling frames and whose produce can be collected by the experimenter himself without the use of paid labour, particularly in the hands of the departmental staff who usually conduct these experiments, cannot be relied upon to furnish correct results. They provide a clear evidence against the adoption of small size plots under the present Indian conditions, particularly those in the temporarily settled parts of India, owing to the very serious risk of bias involved in their use. The considerations of practical convenience and economy advanced in their favour must be considered as all secondary before the question of bias. Even assuming that the difficulty of bias can be got over by evolving precise scientific tools, the results indicate that the use of small-size plots involves a very considerable increase in sampling in order that the yield may be estimated with precision on par with that attained through the use of the existing large-size plot and is unlikely to be economical under Indian conditions, until at any rate such time as facilities for transportation and travel from one village to another change to what they are in England and U.S.A.

1. Panse, V. G., and Kalamkar, R. J., *Curr. Sci.*, **13**, 120–24, and 223–25. 2. Sukhatme, P. V. *Nature*, **154**, p. 299. *Proc. Ind. Aca. Sci.*, **21**, 328–32. *Imp. Coun. Agr. Res. Reports on Crop cutting experimental surveys in Tanjore (Madras) Raipur (C. P. & Berar) Kolaba (Bombay), Punjab & U. P.* 3. Hubback, J. *Imp. Agri. Res. Ins. Pusa, Bull.* 166. 4. Mahalanobis, P. C. *Sankhya*, **7. 1**, 29–106. 5. Cochran, W. G., *Jour. Amer. Stat. Assocn.*, **34**, Pp. 492–510. 6. King, A. J., McCarty, D. E., and Mcpeak, M. *U. S. Dept. Agr. Bull.* 824. 7. Yates, F. *Ann. Eug.* **6.2**, 202–13.

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MILK MARKETING IN INDIA

SUPPLY of inexpensive and adequate quantities of liquid milk is the primary duty of a nation's dairy industry. That in the existing conditions both these requirements are not fulfilled is a painful fact. This subject has been receiving wide publicity during the last ten years but as judged from the standpoint of the needy consumer the position has deteriorated.

This matter has also received the attention of the Government from time to time and it is earnestly to be hoped that something tangible will result from this planning, in the very near future. The latest survey about the Dairy Industry of India has been carried out by Mr. R. A. Pepperall of the Milk Marketing

Board, England.* Mr. Pepperall has investigated afresh the problem of marketing fluid milk; as stated in the introduction, he has tried to avoid contact with previous surveys and data so as not to prejudice his conclusions.

The following are some of the main points gathered by Mr. Pepperall during his suvey. Allowing for the difference in population, India maintains about eight times as many milch cattle as are required for the milk supply of England and Wales. Dairy industry lacks any organisation for which the authorities and the public should share equal blame. India must learn to manage better her stock of indigenous cattle. Government breeding and dairy farms should make available to the people at large, bulls with reliable records and not dispose them of in a half-hazard manner. For better breeding artificial insemination should be organised on a wider scale.

The possibilities of using certain marine plants and dried fish to milch cattle may repay investigation. Cultivation of berseem should be encouraged. Oilseeds and cakes produced in this country should be conserved and used for feeding to cattle and increasing the fertility of the soil rather than sold for export. The problem of disposing off a large surplus of our half-starved stock which cannot be supported should be squarely faced. Milch animals should be mated in proper season rather than carry on till the animal becomes dry when its maintenance becomes increasingly uneconomical. Weaning of young stock is possible and should be encouraged.

Rapid surveys are necessary to assess the cost of production of milk in different parts of the country. To ensure a steady supply of milk the producer must be guaranteed a satisfactory price. Measures should also be found for granting loans for purchasing feeds, etc., thus saving him from the ruinous money-lender.

The hygienic quality of milk is very poor and the authorities concerned should pay greater attention to this question. This will include adequate supervision and education right from the care of animals to the final disposal of fluid milk to the consumers.

All efforts should be made to abolish the present system of maintaining cattle stalls in our cities. For ensuring a sufficient supply of milk to urban areas, regions of supply which are distant from towns and cities and which have water and grazing facilities should be developed. Special rail service, for the transport of milk is an absolute necessity. Premises where milk is produced and processed should be strictly supervised so as to avoid some of the present undesirable features. That these things are possible under Indian conditions is amply demonstrated by the system of milk production and processing followed at the various military dairy farms.

To cheapen the present cost of milk, use of standardised milk (4·0 per cent fat) has been suggested. This will make the same quantity of milk go much further and also give extra fat which can be utilised for butter or ghee manufacture.

Mr. Pepperall rightly suggests that the dairy industry should not look up to the Government to do everything but cultivate an independent outlook and become self-supporting. To reorganise the dairy industry, creation of Milk Commissions has been suggested, which should be independent of direct Government control. The duties of such a Commission will be to stimulate milk production and improve the quality of milk; organise co-operative societies; provide loans to farmers, encourage systematic breeding; arrange for the removal of animals from city areas and develop new promising areas; investigate into the cost of milk production and distribution; supervise the disposal of surplus milk; prepare and sell standardised milk; issue the requisite licences to producers, distributors and manufacturers; dispose off unthrifty animals; reorganise the supply and distribution of milk in cities; and in short, control all the activities pertaining to the dairy industry with the mutual consent and co-operation of all the interested parties.

The above recommendations are not new to our readers and the best suggestion that we can now offer is for early action. In the beginning the Government will have to take some initiative but later on these activities may be left entirely in the hands of milk commissions of the type suggested. The problem is so big that we do not expect that everything will fit in with the paper plans but without such failures no progress will ever be made In the beginning we must concentrate our energy and resources on the production and distribution of liquid milk. Unless plenty of cheap and clean milk can be assured for our growing population it may not be desirable to build factories for the manufacture of Western types of milk products like dried and evaporated milks. Till our liquid-milk market is organised on a firmer basis these products can easily be imported from areas where they are economically produced. Any reorganisation of dairy industry brings in the question of transport. So far, this has been and still remains the bottle-neck. With all the railways under Government control there should be no difficulty in extending all the facilities required by the dairy industry. Along with our railroads, a proper milk supply should be accounted as the life-line of the nation.

In the modern world no problem can be solved without research. The prime importance for our dairy industry is to solve the liquid-milk problem of the nation and for the time being at least all our research activities should primarily be directed to this end. This work will include gathering accurate knowledge about the composition of milk, methods for assessing the quality of milk, increasing the life of milk and developing new methods for storage and transport which are best-suited to the climatic conditions of this country.

* "The Dairy Industry of India,"—Report on and investigation with recommendation, 1945, published by the Department of Education, Health and Lands, (now Dept. of Agriculture), Govt. of India, New Delhi."

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LETTERS TO THE EDITOR

ULTRAVIOLET BANDS OF ZINC IODIDE

Analysing the emission bands of HgF into two systems, Howell[1] has shown them to be due to $^2\pi - ^2\Sigma$ transition between Hg atom-like levels, the doublet separation being related to ^3P width of the Hg atom. This view was confirmed by one of the authors[2] from the band systems of HgCl and HgI.

Howell also indicated that a probable similarity in electronic transition should be found in the band spectra of the halides of zinc. But only among ZnF^3 and $ZnCl^4$ bands was a doublet separation of 370 cm.$^{-1}$ and 383·5 cm.$^{-1}$ respectively detected with certainty, approximately equal to the corresponding atomic coupling constant 386 cm.$^{-1}$

In the light of this, the authors have investigated the ZnI bands. Two systems are found in the appropriate region. One of these was established previously by Wieland.[5] The second is newly found consisting of 10 bands (Wieland has mentioned three of these). They are seen as diffuse pairs between λ 3280 and λ 3170, and could be arranged into two v' progressions with $v'' = 0$ and I. The (0,0) band is suggested at ν 30499·5, the interval between which and the (0,0) band (ν 30129·5) of the first system being 370 cm.$^{-1}$ It agrees closely with the predicted value for the zinc halides. A full discussion will be published shortly.

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Guntur,
March 15, 1946.

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IDENTIFICATION OF TIMBER WOODS BY THE METHOD OF LIGHT-SCATTERING

In a previous note in this *Journal*,[1] the authors have reported the results of depolarisation measurements of the transversely-scattered light in aqueous timber wood extracts. It was shown therein that, under identical conditions of extraction, the factors of depolarisation of the scattered light were unique for each extract. The reproducibility of the reported results is, however, governed by the various conditions of experiment, *viz.*, the weight of the shavings of the timber wood, the volume of the water used and the period and manner of supply of heat for preparing the extracts. These factors cease to be significant only when the extracts are saturated. The authors have, therefore, carried out depolarisation measurements in saturated timber wood extracts with a few organic liquids.

The timber woods used in the present work are: (1) Pink cedar (*Acrocarpus fraxinifolius*; (2) White cedar (*Chikrassia tabularis*); (3) Jack wood (*Artocarpus integrifolia*); (4) Teak wood (*Tectona grandis*); and (5) Rose wood (*Dalbergia latifolia*). Fine shavings of these specimens were obtained by planing and were thoroughly dried by keeping them in a desiccator for two days. The extracts were prepared from the dried shavings with the help of the Soxhlet apparatus. A period of 4-6 hours of continuous extraction was found to be quite adequate for the resulting solutions to become completely saturated. The procedure adopted for rendering the extracts mote-free and the experimental arrangements for determining the depolarisation factors ρ_u, ρ_v and ρ_h[2] were exactly the same as described in the previous note.

The results obtained with the ether extracts of the above specimens are reproduced in Table I. The tracks of the scattered light in all these extracts were easily comparable, the influence of fluorescence being negligible. In no case was ρ_h found to depart from unity.[3]

TABLE I

Extract	Colour of extract	ρ_v%	ρ_u% Observed	
Pink cedar	very slightly yellowish	6·2	11·1	11·7
White cedar	colourless	33·7	52·0	50·4
Jack wood	slightly yellowish	28·4	46·1	44·3
Teak wood	slightly yellowish	30·7	49·3	47·0
Rose wood	red	56·8	72·9	72·4

It is at once seen from Table I that the values of ρ_u and ρ_v are unique for each specimen, the only experimental condition for their reproducibility being that the extracts should be saturated. These values can, therefore, be relied upon for the identification of the respective timber woods. The unitary value of ρ_h denotes that the extracted material, in all these cases, is so dispersed in the ether that the size of the scattering centre is small relative to the wave-length of the light used. This is very much unlike what was found in the case of the aqueous extracts. The optical anisotropy of the scattering elements is lowest in the almost colourless pink cedar extract and maximum in the red-coloured rose wood extract.

Details will be published elsewhere.

The authors' thanks are due to Prof. P. Bhaskara Pannikar, Head of the Chemistry Department, and Prof. R. N Selvam, Head of the Physics Department, Pachaiyappa's College, Madras, for their helpful interest during the progress of this investigation.

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EMISSION BANDS OF BROMINE

Low pressure bromine vapour obtained by heating cupric bromide and kept in flowing condition, was excited by low power high frequency oscillations of about 700 Kc/sec. The spectrum of the discharge was photographed on E_1, E_2 and medium quartz Hilger spectrographs using superpanchropress P1200 and process regular B 20 Kodak plates. The spectrum exhibits a series of ill-defined diffuse bands which extends from about 4200 to 2200 A and can be conveniently described in two sets. The first set starts with weak bands and ends in two groups of fairly intense bands the maxima of which are at 3549·4 and 3336·6 A respectively. The second set starts with two intense groups of bands maxima of which are at 2900·4 and 2753·6 A respectively, and ends in a number of groups of bands which diminish in intensity towards the shorter wave-lengths.

As in the emission spectrum of iodine, these bands in bromine appear as a series of diffuse and more or less broad bands which are, therefore, be referred to as fluctuation bands. The average width of bands in the first set is of the order of 230 cm.$^{-1}$, three of them at 4224·5, 3549·1, 3336·6A, being however much broader. The bands in the second set are much less broad, the average width being of the order of 130 cm.$^{-1}$, the stronger bands again showing a slightly greater breadth. The data are given in Table I.

The bands are thus apparently similar to those of iodine, but are, however, bodily displaced towards the shorter wave-lengths. An-

TABLE I. *First set of bands*

Group	Int.	λ in air, A.	ν Vac.	Group	Int.	λ in air, A.	ν Vac.
I	4	4224·5	23665	II	10	3549·4	28166
	1	4090·4	24441		4	3420·2	29230
	1	4021·5	24859		6	3366·8	29693
	3	3932·5	25422	III	10	3336·6	29962
	2	3849·7	25969		1	3268·6	30585
	?	3809·2	26245		1	3239·2	30863
	2	3739·7	26733				
	4	3597·8	27787				

Second set of bands

Group	Int.	λ in air, A	ν Vac.	Group	Int.	λ in air, A.	ν Vac.
I	1	2980·9	33537	V	6	2526·9	39562
	1	2952·0	33865		6	2510·9	39814
	8	2923·8	34192		6	2494·2	40081
	10	2900·4	34468		7	2478·8	40330
	8	2872·5	34803		4	2464·8	40559
	4	2844·2	35149		3	2452·6	40761
	5	2814·3	35522	VI	2	2444·4	40897
II	7	2780·6	35953		2	2432·3	41101
	8	2753·6	36305		4	2421·1	41291
	7	2732·4	36587		?	2406·8	41536
	7	2709·8	36892	VII	?	2388·0	41863
	5	2688·7	37182		2	2375·0	42092
III	4	2654·8	37656		3	2360·8	42346
	6	2638·9	37883		2	2349·4	42551
	6·2	2623·1	38111		1	2337·9	42760
	?	2608·9	38319		2	2326·3	42979
IV	5	2580·6	38739		2	2313·9	43204
	5·2	2564·7	38979		1	2304·5	43380
	2	2549·3	39215	VIII	?	2288·0	43693
					?	2261·1	44212
					?	2234·9	44731
					?	2212·8	45180
					?	2196·6	45511

other striking difference between these and the iodine bands is that while the latter, particularly those towards shorter wave-lengths, occur in clearly marked and definite groups somewhat like sequences, the bromine bands are much less pronounced and more diffuse. Probably this tendency is developed still more in chlorine where only continuous bands are recorded.

I am grateful to Dr. R. K. Asundi for his valuable guidance and to Prof. S. P. Prasad and Prof. D. K. Bhattacharya, Science College, Patna, for permission to use E_1 and E_2 quartz spectrographs.

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CONSERVATION OF THE MINERAL WEALTH OF INDIA

THIS is an age of minerals, but they are vanishing assets. Their efficient use is, therefore, a matter of vital national concern and greatest attempts are, therefore, being made in every country to affect as much conservation as possible by eliminating all possible wastage to prolong the life of the deposits. With this object in view the authorities concerned have turned their attention to the mica deposits of India. The writer believes it to be the aim of everybody concerned to bring to the notice of the public, wherever any avoidable wastage of mineral wealth may be occurring. He has noticed some glaring examples, some of which are mentioned below.

In quarrying limestone near Katni in the Jubbalpore district, a great overburden of clay, about 40 feet in depth, has to be removed. This clay is mainly whitish with reddish,

brownish, yellowish and greenish streaks in places. This clay is already being used in the Katni Pottery Works. But what was noticed in Bajan and Co.'s quarry and in fact in many other quarries, was that good clay along with the overlaying dark-coloured soil was being dumped in the adjoining fields. Evidently, the clay on being mixed with the dark-coloured soil and so dumped is rendered impure. The overburden being huge, thus very large quantities of the clay are wasted. In places hillocks of this material are to be seen, which, as a result of erosion by heavy rainfall during the monsoon season show deep ravines on their sides. First the clay is rendered impure and secondly it is allowed to be washed away freely by rain, when it could be put to good and profitable use.

In the neighbourhood of Katni it was also found that good iron ore was being used as road metal and literally numerous stacks of this mineral were still lying alongside some of the roads. It is a good, hard brownish-black limonite with about 59 per cent. of iron. Its specific gravity was determined to be 3·60. It may be noted that limonite deposits in Lorraine and Luxemburg constitute the most important iron ore deposits of Europe. It is also mined in Sweden, the Harz Mountains, etc. Besides, being an ore of iron, it is also used as a yellow mineral pigment. But in the neighbourhood of Katni its use as a road metal is indeed surprising and that too when unlimited resources of road metal from the Vindhyan sandstone and limestone occur in the same area.

The writer was informed by Mr. Govind Prasad Sharma of Katni that barytes of good quality has been used as ballast on the railway line near Rupaunda railway station, while again unlimited quantities of the Vindhyan rocks are available for the purpose only a short distance away.

Barytes, which is sold to the paint works of the New Industries Ltd., Katni, was observed to contain very good fluorspar, violet in colour, but it was sold with the barytes making it an off-colour second quality. Fluorspar is a mineral in demand in India by the Steel and Aluminium Works. It also finds a number of other important uses. It certainly deserves to have been separated thus raising the price of the barytes and the fluorspar.

Fireclay is being quarried a little more than half a mile north-west of Bhaganwara, which is about 5½ miles north-west of Sleemnabad Road railway station on the Katni-Jubbulpore line. The method of working this deposit is that a pit is dug for extracting the clay. It is remarkable that there is absolutely no percolation of water in the pit, even when it is deep. With the advent of rains, the work is stopped and the deep pit naturally gets filled with water. Next year the old pit remains abandoned and a new site is chosen. This process is repeated and to-day several deep pits and tortuous channels filled with water are to be seen. This procedure tends to spoil the deposit and is certainly not conducive to the conservation of the important deposit of fireclay, a material greatly in demand for manufacturing refractories. It would be indeed unfair and unprofitable to future working as all the water will have to be baled first and then work will have to be carried out in deeper portions. With regard to the depth of the deposit, a deep pit to a depth of 80 feet was put down and it had not touched the base of the clay deposit. The systematic procedure to work this deposit would be to work from one end and to win all the clay to the base of the deposit.

In conclusion, it may be observed that these are only a few of many like cases, and these have been placed before the public in order to make us more conservation-minded with regard to our mineral deposits as once a mineral is lost, it cannot be replaced.

Soil is another mineral resource, the extremely rapid erosion of which deserves to be checked. Dr. Twenhofel has described it as the most valuable mineral resource. This subject is of course too lengthy for this communication and it is gratifying to note that it is already receiving at least some attention. Our utmost attempt should be to ensure the greatest longevity of the mineral deposits. It is only thus that we can save and ameliorate the condition of human life in this country.

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January 30, 1946.

HEAT OF REACTION, FREE ENERGY OF REACTION AND ENTROPY CHANGE IN BUTADIENE 1-3 FORMATION FROM BUTENE-1

Ghosh and Roy[1] have applied the general specific heat equation $\Delta C_p = 6{\cdot}86 - 0{\cdot}0046\,T + 0{\cdot}000{,}0006\,T^2$ for all dehydrogenation processes involved in the formation of olefines from paraffins and diolefines from olefines of the *n*-butane and isopentane series, since accurate values for the specific heat of only *n*-butane, butene-1 and hydrogen were then available.

Two sets of reliable values are now available for the specific heat of gaseous butadiene-1, 3. Templeton, Davies and Felsing[2] claim less than one per cent. error in their values and propose the equation $C_p = 3{\cdot}32 + 0{\cdot}0316\,T$ (the second term has been put as $0{\cdot}516\,T$ due to a printing error in their paper) for the specific heat of butadiene-1, 3. Scott and Mellors[3] claim less than 0·5 per cent. error in their values which give $C_p = 2{\cdot}27 + 0{\cdot}0566\,T$ as the empirical equation for the specific heat of butadiene-1, 3. The data of Templeton, Davies and Felsing[2] are systematically lower than those obtained by Scott and Mellors[3] the maximum difference amounting to 3 per cent., which is larger than can be expected from a consideration of the expected errors.

On the basis of these values for the specific heat of butadiene-1, 3 in conjunction with

TABLE I

Reference	Specific heat equation	Equation for standard-free energy of reaction	ΔH°_{298} cals.	ΔF°_{298} cals.	ΔS°_{298} E.U.
1	$\Delta C_p = 6 \cdot 86 - 0 \cdot 0046\,T + 0 \cdot 000{,}0006\,T^2$	$\Delta F_T = 25{,}496 - 6 \cdot 86\,T \ln T + 0 \cdot 0023\,T^2 - 10^{-7}\,T^3 + 20 \cdot 03\,T$	27,342	20 015	24·6
2	$\Delta C_p = 5 \cdot 6 + 0 \cdot 000186\,T + 0 \cdot 000{,}0006\,T^2$	$\Delta F_T = 25{,}281 - 5 \cdot 6\,T \ln T - \cdot 000093\,T^2 - 10^{-7}T^3 + 13 \cdot 76\,T$	26,967	19,761	24·2
3	$\Delta C_p = 4 \cdot 55 + 0 \cdot 0052\,T + 0 \cdot 000{,}0006\,T^2$	$\Delta F_T = 24{,}726 - 4 \cdot 55\,T \,\mathrm{Ln}\, T - 0 \cdot 0026\,T^2 - 10^{-7}\,T^3 + 9 \cdot 42\,T$	26,378	19 512	23·04

other data given in the original paper,[1] the thermodynamic characteristics of the reaction

$$\text{Butene-1} \leftrightarrows \text{Butadiene 1-3} + H_2$$

have been evaluated and compared with the values assigned previously by workers in this laboratory.[1] The results are given in Table I.

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1. Ghosh and Roy, *Curr. Sci.*, 1945, **14**, 156. —, *Proc. Nat. Inst. Sci.* (*India*), 1946, **22**, 115. 2. Templeton, Davies with Felsing, *Jour. Amer. Chem. Soc.*, 1944, **66**, 2033. 3. Scott and Mellors, *J. Research NBS.*, 1945, **34**, 243.

PRODUCTION OF HYPOPROTHROMBINAEMIA IN THE RAT BY FEEDING SULPHATHIAZOLE AND ITS CURE WITH SYNTHETIC VITAMIN K

SINCE Dam, Schonheyder and their associates[1,2] conclusively showed that a deficiency of vitamin K in the chick resulted in a hæmorrhagic syndrone characterised by lowered prothrombin level, many attempts have been made to produce the same symptoms in common laboratory animals. These have resulted mostly in the development of methods which depend on some form of surgical procedure which inhibits the absorption of vitamin K and thereby brings about a deficiency of this vitamin in the animal.

The work of Greaves and Schmidth[3] on rats as well as that of Dam, Schonheyder, and Lewis[4] shows, that in general mammals are not very susceptible to a purely dietary deficiency of vitamin K.

The observation that the intestinal bacteria inhabiting the intestines of most mammals are a potent source of vitamin K have recently led to the development of methods for producing vitamin K deficiency in the rat. Daft, Kornberg and their co-workers[5,6] as well as Black *et al.*[7] report that continual feeding of sulphonamide drugs to rats, together with a synthetic ration free from vitamin K can consistently produce hypoprothrombinæmia.

These findings suggest a convenient method for producing vitamin K deficiency in the rat which has potentialities of being developed into a curative method for the assay of this vitamin.

With this object in view, further data are presented, concerning the production of hypoprothrombinæmia in the rat using sulphathiazole in conjunction with a diet free from vitamin K, and its correction with synthetic vitamin K.

Three groups of male albino rats from the Haffkine Institute stock colony, about a month old, and weighing 25 to 40 grams were used. The synthetic ration given to the animals was the same as that used by Kornberg *et al.*[8] with the exception that the vitamin B complex supplement was supplied in the form of dried brewer's yeast.

The first group of animals was kept on the vitamin K-free diet supplemented with sulphathiazole at 1 per cent. level and 100 μg. of synthetic vitamin K per week.

The second group of animals received the same ration as the first group but without the vitamin K supplement.

The third group received the same ration as the other two groups but without supplement of vitamin K or the drug.

Prothrombin estimations were made by a modified micro method of Innes and Davidson[9] in which the prothrombin in the first drop of blood obtained by clipping the tail was determined.

Purified Russel's viper venom was used as the source of thromboplastin. The supplement of vitamin K was given orally once a week.

It was found that in the first two weeks the animals appeared quite healthy. During the third week the animals of the second group showed an abrupt change in their general condition. They seemed very weak and extremely pale (as seen from the eyes and ears), while some showed bleeding from the ears and nose.

Prothrombin determinations made at this juncture showed that in the majority of animals in this group, a severe prothrombin deficiency had developed, whilst the prothrombin level of the other two groups remained normal. These results indicate that inclusion of vitamin K could prevent the hypoprothrombinæmia produced by the drug. They also showed that a pure dietary deficiency could not be produc-

ed very easily in the rat. The animals of group 3 were kept on the same diet deficient in vitamin K for two and half months, but even then there was no deficiency of this vitamin produced as judged by the prothrombin level. At the end of this period the animals were killed and on dissection they appeared to be normal.

With a view to study whether the administration of vitamin K could cure the severe hypoprothrombinæmia produced in the second group of animals, 100 μg. of vitamin K were given by mouth to the animals of this group when they developed a severe deficiency of prothrombin, and the prothrombin time was determined at the end of 48 hours. It was seen that in the majority of cases the prothrombin returned to the normal value during this period. Those animals that did not receive vitamin K did not survive more than a month.

Some of the results illustrating the above observations are given in the following tables:

TABIE I. *Group ii*

Animals of this group received vitamin K-free diet containing 1 per cent. sulphathiazole.

No. of rat	No. of days on diet	Prothrombin time	No. of days after receiving 100 μg. of vitamink	Prothrombin time after receiving supplement
14	18 days	45 seconds	2 days	12 seconds
21	21 ,,	100 ,,	2 ,,	13 ,,
28	18 ,,	90 ,,	2 ,,	15 ,,
29	18 ,,	80 ,,	2 ,,	15 ,,

TABLE II. *Group i*

Animals of this group received vitamin K-free diet containing 1 per cent. sulphathiazole and 100 μg. vitamin K per week.

No. of rat	No. of days on diet	Prothrombin time	No. of days on diet	Prothrombin time	No. of days on diet	Prothrombin time
7	16 days	17 sec.	44 days	15 sec.	60 days	15 sec.
9	24 ,,	16 ,,	44 ,,	17 ,,	72 ,,	18 ,,
10	19 ,,	18 ,,	44 ,,	15 ,,	62 ,,	18 ,,
12	19 ,,	17 ,,	38 ,,	20 ,,	67 ,,	18 ,,

TABLE III. *Group iii.*

Animals of this group received vitamin K-free diet.

No. of rat	No. of days on diet	Prothrombin time	No. of days on diet	Prothrombin time	No. of days on diet	Prothrombin time
1	26 days	18 sec.	47 days	18 sec.	60 days	sec. 17
2	24 ,,	17 ,,	47 ,,	18 ,,	60 ,,	15 ,,
3	24 ,,	16 ,	47 ,,	15 ,,	60 ,,	17 ,,
4	24 ,,	16 ,,	47 ,,	18 ,,	60 ,,	18 ,,

Experiments are now in progress to determine the minimum dose of vitamin K required to bring back to normal the prothrombin time of animals made deficient by the above method.

In order to study the effect of continued feeding of the drug on the liver, some animals were made deficient as described above and sacrificed when a severe hypoprothrombinæmia developed. On dissection, it was found that in the majority of cases, the liver was enlarged and pale. Hæmorrhages were found in various parts of the body, the most common sites being the subcutaneous tissues, the urinary bladder, the epididymis, testicles and the pelvic region. Histological examination of the livers showed fatty infiltration and, in some cases, necrosis of the parenchyma.

A detailed account of these investigations will be published elsewhere.

We wish to thank Sir Sahib Singh Sokhey for his kind interest and encouragement in this work.

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OCCURRENCE OF KANUGIN IN THE STEM BARK OF *PONGAMIA GLABRA*

THE root and bark of *Pongamia glabra* are stated to find several uses in Indian medicine.[1] Examination of the root some time back[2] revealed the existence of a crystalline component

which has been designated kanugin. The constitution of kanugin has recently been established[3] as 3:7:3′-trimethoxy-4′:5′-methylenedioxy-flavone and this has been confirmed by synthesis.[4] A study has now been made of the stem bark with a view to isolate any crystalline compounds present therein.

The coarsely powdered air-dried stem bark was repeatedly extracted with hot ligroin. The combined extracts were concentrated first by distillation to recover the solvent and subsequently by heating on a water-bath in an open evaporating basin. The residue was taken up in a slight excess of hot alcohol and treated with water little by little till all waxy and resinous matter separated out. After filtration the aqueous alcoholic solution was evaporated almost to dryness and the solid residue recrystallised from dilute alcohol repeatedly whereby a light colourless solid (stout needles and narrow rectangular rods) melting at 200–202° was obtained. It was moderately soluble in organic solvents and insoluble in dilute sodium hydroxide even after boiling for a few minutes. Its alcoholic solution did not give any colour with ferric chloride. Concentrated sulphuric acid dissolved it to give a yellow solution with a green fluorescence slowly changing into red; a bluish-violet fluorescence was exhibited even by a dilute alcoholic solution. On reducing an alcoholic solution with magnesium and hydrochloric acid a pink colour was produced indicating that it belongs to the group of flavones, while the formation of a deep emerald green colour on warming with sulphuric acid and gallic acid furnished proof of the presence of one or more methylene-dioxy groups in the molecule. Combustion analysis gave the value 64·3 per cent. for carbon and 4·8 per cent. for hydrogen. The above reactions and the elementary composition suggested that the substance should be identical with kanugin. A mixed melting point determination confirmed the identity.

Thus kanugin occurs in both the root and stem of *P. glabra*. Occurrence of the same compounds in different parts of the same plant, particularly in the root and stem, is fairly common; cinchona and liquorice may be quoted as familiar examples. The yield of kanugin, however, is very much lower from the stem bark, being about a tenth of the yield from the root bark. No other crystalline compound could be obtained from the stem bark.

The author's thanks are due to Prof. T. R. Seshadri for his interest in this work.

Andhra University, S. Rangaswami.
February 27, 1946.

1. *Indian Medicinal Plants*, by Kirtar and Basu, **1**, 830. 2. Rangaswami, Rao and Seshadri, *Proc. Ind. Acad. Sci.*, 1942, **16A**, 319. 3. Rajagopalan, *et al.*, *Ibid.*, 1946, **23**, 60. 4. Rao and Seshadri, *Ibid.*, **23**, 147.

THE pH OF SODIUM BORATE SOLUTIONS—A USEFUL BUFFER MIXTURE

The determination of the hydrogen-ion concentrations of solutions containing boric acid and sodium hydroxide in which the ratio $Na_2O:B_2O_3$ was varied between 3:1 and 1:5, was made at 30° C. using the glass electrode. The curves obtained for the different concentrations of the solutions by plotting pH against the ratio $Na_2O:B_2O_3$ brought to light a striking fact that these curves intersect at one point corresponding to a value of Ratio = 1.2·425. A solution of sodium borate containing this ratio of $Na_2O:B_2O_3$ is obviously such that its pH remains unaltered when diluted from 0·15 N to 0·005 N. A solid mixture with this ratio of $Na_2O:B_2O_3$ when dissolved in any quantity of water within the range indicated by concentrations used in this work would give a pH = 8·91.

Kiehl and Loucks[1] have measured at 30° C. the pH of $NaBO_2$ and $Na_2B_4O_7$ over a wide range of concentrations. It is interesting to note that these values are in good agreement with those obtained in this investigation. This is brought out in the following table:—

Concentration in Normality	0·05		0·10		0·15	
Solution	K & L	Authors	K & L	Authors	K & L	Authors
$NaBO_2$ i.e., $Na_2O:B_2O_3 = 1:2$	10·43	10·38	10·68	10·51	—	—
$Na_2B_4O_7$ i.e., $Na_2O:B_2O_3 = 1:2$	9·16	9·13	9·15	9·14	9·18	9·18

S. M. Mehta.
S. G. Desai.
The Royal Institute of Science,
Bombay 1,
March 14, 1946.

1. *Trans. Electrochem. Soc.*, 1935, **67**, 81.

THE ELECTRICAL CONDUCTIVITY OF AMPHOTERIC OXIDES IN CONCENTRATED SOLUTIONS OF ALKALIS

A detailed study of the behaviour of amphoteric oxides towards solutions of alkali hydroxides has been undertaken. During the course of this work the electrical conductivity of solutions of aluminium hydroxide when dissolved in hydroxides of sodium and potassium (between 10 N and 0·5 N) is measured. The results obtained can be represented by the expression $\log \frac{\Lambda_1 - \Lambda_2}{\Lambda_1} = m\sqrt{N} + c$, where m and c are constants, N = normality of the alkali, Λ_1 = equivalent conductivity of the alkali, Λ_2 = equivalent conductivity of the alkali + aluminium hydroxide. The values of $\sqrt{N}$ for the ratio $\log \frac{\Lambda_1 - \Lambda_2}{\Lambda_1} = 0$ were obtained graphically. At these values, the conditions are such that Λ_2 must become equal to zero. Attempts are made to verify this conclusion

experimentally and when aluminium foil is dissolved in 11N sodium hydroxide, a solution is obtained which has a very high resistance and the equivalent conductivity is about 0·1 mho.

The applicability of the above expression is tested in the case of solutions of zinc hydroxide and the alkali systems by one of us (S. M. M.) with another student (M.B. Kabadi) and it is found to hold good.

Full details of these investigations will be published shortly.

S. M. Mehta.
V. T. Sheth.

The Royal Institute of Science,
Bombay,
March 14, 1946.

THE ELECTRICAL CONDUCTIVITY OF CONCENTRATED SOLUTIONS OF SODIUM AND POTASSIUM HYDROXIDE

During the course of investigations on the behaviour of amphoteric oxides towards solutions of alkali hydroxides it was found necessary to have values at 30° C. of the electrical conductivities of concentrated solutions of these alkalis. From a search of the literature it was revealed that these values have not been determined and the investigators who have found these values have not done so for the whole range of concentrations at a given temperature. The electrical coductivities of concentrated solutions of sodium and potassium hydroxides were, therefore, determined at 30°± 0·1°. The data obtained are tabulated below:—

N	NaOH			KOH	
	Observed	Bousfield and Lowry	Gmelin	Observed	I. C. T.
10	30·3	30·0	..	60·4	..
8	49·8	49·4	..	84·9	..
7	60·0	60·0	..	98·0	..
6	75·4	75·8	..	117·7	..
5	92·6	91·0	..	135·0	..
4	110·8	111·0	..	158·1	..
3	130·9	132·5	..	179·5	..
2	158·0	160·0	..	205·3	..
1	197·0	196·0	..	232·9	233·0
0·5	214·4	..	214·4	250·0	248·0
0·2	231·0	..	231·0	261·7	262·0
0·1	240·0	..	239·0	268·5	267·0
0·01	250·8	..	251·0	277·3	278·0
$1/\alpha$	268·0	..	267·0	292·0	293·0

In the above table some of the values experimentally obtained for sodium hydroxide have been compared with those calculated from the results of Bousfield and Lowry[1] and also with those for dilute solutions calculated from the data available at different temperatures in Gmelin.[2] In the case of potassium hydroxide, the values for dilute solutions at 30° C. are available in the International Critical Tables[3] but for those for higher concentrations could not be obtained. It will be observed that the values experimentally determined compare very well with those found and evaluated from the data in the literature.

S. M. Mehta.
M. B. Kabadi.
V. T. Sheth.

The Royal Institute of Science,
Bombay, 1,
March 15, 1946.

1. Bousfield and Lowry, *Phil. Trans.*, A, 1905, **204**, 305. 2. Gmelin, *Handbuch der anorg. Chemie*, 1927, **2**, 229. 3. *International Critical Tables*, **6**, 254.

THE MELTING POINT OF ORTHO-BORIC ACID

The evidence obtained so far in support of the fact that orthoboric acid combines with many hydroxylic substances to form complex compounds is based on a study of some of the physical properties of aqueous solutions containing boric acid and the hydroxylic substances. But a search of literature revealed that no attempts have been made so far to construct the melting point composition curves of mixtures of ortho-boric acid with other substances. The reason for this is probably to be found in the fact that ortho-boric acid decomposes on heating. According to Merz[1] it is stable up to 70° C. while Lescoeur[2] found the temperature of stability to be 100°C. From the work of Stackelberg, Quatram and Dressel[3] it appears that ortho-boric acid is stable upto 140° C. Whatever the exact temperature upto which ortho-boric acid is stable it is clear that if the melting points of mixtures of boric acid with other substances are below 100° the decomposition of boric acid may be considered absent or negligible while studying the melting point diagram. In trial experiments with mixtures of boric acid with certain hydroxylic substances it was found that the melting points of these mixtures are below 100° C.

With mixtures of ortho-boric acid and glucose, galactose and tartaric acid it was found that the melting point diagrams are of the eutectic type although it is noticed that the two branches of the curves are not straight lines intersecting at the eutectic point. By drawing tangents to the curves parallel to the axis of composition the following data are obtained :—

Substance	Mol. per cent. boric acid	Minimum temp.
Glucose	45·8	51·7
Galactose	49·3	50·0
Tartaric acid	51·5	62·0

Using the expression given by Kordes[4,5] the melting point of ortho-boric acid was calculat-

ed from the above data. It was found that the calculated values of the melting point of ortho-boric acid were 169·5° C. and 170·5° C. respectively with mixtures containing glucose and galactose. These values are in good agreement with 170° C. given by Stackelberg. Quatram and Dressel[3] which they obtained using an entirely independent and elaborate method. The value obtained with mixtures containing tartaric acid is low being 160 9° C. and this may be due to complex formation. Full details of this investigation will be published shortly as also the melting point diagrams of mixtures of boric acid with mannitol and erythritol.

S. M. MEHTA.
(MISS) K. V. KANTAK.
The Royal Institute of Science,
Bombay,
March 11, 1946.

1. Merz, *Journ. prakt. Chem.*, 1866, **99.** 179. 2. Lescoeur, *Ann. Chim. Phys.*, 1890, (6), **19,** 43. 3, Stackelberg, Quatram and Dressel, *Zeit. Electrochemie*, 1937, **43,** 14. 4. Kordes, *Zeit. anorg. Chemie*, 1927. **167,** 99. 5. *ibid.*, 1928, **168,** 177.

ON THE KINETICS OF ENZYME REACTIONS

IN a recent paper[1] it was shown that the substrate molecules may be activated by the enzymes by virtue of some kind of resonance between the enzyme molecules and the substrate molecules. We intend to develop here the idea further and attempt at deducing some well-known laws of enzyme kinetics.

The number of collisions between the enzyme molecules and the substrate molecules will be $= K_1ES$, where

$E =$ Concentration of enzyme
$S =$ Concentration of substrate
$K_1 =$ Constant.

Of this total number of collisions only a small fraction will be able to decompose (some of the primary activated molecules may also be deactivated before reaching the secondary activated state).

Hence, let the concentration of those which decompose be $= KES$. Now, when in the process of activating the substrate molecules the enzyme molecules have imparted their extra energy to the substrate, they fall into an inactive state from which after a definite but small time interval, they again (by absorbing energy) come to the active state, and can again cause the decomposition of a fresh amount of substrate which will be equal to

$$KE(S - KES) = KES(1 - KE).$$

Similarly, the process will be repeated producing successive decomposition of substrates

$$KE\{S - KES - KE(S - KES)\} = KES(1 - KE)$$

and so on.

Thus, Y, the total decomposition after time t, is given by

$$Y = KES + KES(1 - KE) + KES(1 - KE)^2 + \ldots n \text{ terms},$$

where n denotes the number of such cycles performed in time t.

Hence,

$$Y = \frac{KES\{1 - (1 - KE)^n\}}{1 - (1 - KE)} = S\{1 - (1 - KE)^n\}$$
$$= S\{1 - (1 - KE)^{At}\}$$

(since n will be directly proportional to t).

From the above equation it follows:

(*i*) that during the initial stages of the reaction when t is small,

$$Y = S\{1 - KE\,At)\} = S.K.E.A.t$$

$Y \alpha S$ when E and t are constants.
$Y \alpha t$ „ S and E „ „
$Y \alpha E$ „ S and t „ „

(*ii*) *Since*

$$Y = S\{1 - (1 - KE)^{At}\}$$
$$\frac{S - Y}{S} = (1 - KE)^{At}$$
$$\ln \frac{S - Y}{S} = -At \cdot \ln(1 - KE)$$
$$= KE \cdot At$$
(since KE is small)
$$= K't.$$

This is the well-known monomolecular law for the enzyme reactions. It is evident from the deductions that deviations from the unimolecular law may very well be expected in cases where the enzyme concentration is high or when KE is not small compared to unity (*cf.* Straus and Goldstein[2]).

Biochemical Laboratory,
Bose Research Institute,
Calcutta, A. K. RAI CHAUDHURY.
April 17, 1946.

1, Rai Chaudhury, *Curr. Sci.*, 1945. **14,** 261. 2. Straus and Goldstein *J. Gen. Physiol.*, 1942–3, **26,** 539.

ON THE ESTIMATION OF METHIONINE BY COLORIMETRIC PROCEDURE

THE methods generally followed are idometric, gravimetric and colorimetric. The latter are usually preferred as they are quick and accurate. It is claimed that McCarthy and Sullivan's[1] method is specific for this amino acid and as such was adopted in this laboratory for the estimation of its contents in various pure strains of cereals and pulses grown in the Presidency. During the course of this work it was found that the large amount of carbohydrate in the vegetable foodstuffs interfered with the development of the color. And it was almost impossible to match the unknown with the standard solutions of methionine by visual colorimeter. Various attempts were made to eliminate the source of difficulty and with the technique of trial and error the following procedure was adopted.

(*a*) *Compensating for the interference by carbohydrates.*—Owing to yellow tinge which developed on the addition of reagents and which is primarily due to the breakdown products of carbohydrates during hydrolysis was compensated by adding a calculated amount of hydrolysed starch (amylum) to the standard solution before the addition of the reagent. This procedure developed colours in both standard and unknown which could be easily matched.

(*b*) *Substituting phosphoric acid* (85%) *for*

the H PO -HCl buffer.—Probably due to more rapid change of pH by H_3PO_4-HCl mixture the final color sometimes was dirty brown or dark green. It was difficult to match with the standard. This difficulty was obviated by using H_3PO_4 in place of the buffer mixture. The acid did not give rise to dirty green tinge or any other color interference even when an excess was added.

(*c*) *Introducing known amount of methionine into the unknown sample*.—Preliminary experiments have shown that quantities of methionine less than 1 mg. per 15 c.c. gave faint color which could not be matched. The vegetable foodstuffs are usually poor in methionine, hence this difficulty was invariably encountered. Addition of known amount of methionine to the unknown removed this difficulty without affecting the final results.

The procedure in short is as follows:—

5 gm. of cereals were hydrolysed by 20 per cent. HCl in an oil-bath maintained at 125° C. for 6 to 8 hours. The solution was made 100 c.c. volume and filtered. 5 c.c. aliquot was taken in a wide pyrex test-tube 2 c.c. of standard methionine containing 1 mg. was then added. The solution was made strongly alkaline and 1 ml. of 1 per cent. glycine 0·3 ml. of 10 per cent. sodium nitro prusside (freshly prepared) were added. Second tube containing 2 c.c. standard methionine and 5 c.c. of amylum hydrolysate was similarly treated. The tubes were placed in a water-bath at 35-40° C. for ten minutes and were cooled in ice water for further ten minutes. Phosphoric acid was added drop by drop and with vigorous shaking after each addition. The end-point of the reaction was marked by effervescence which slowly gave place to specific methionine color. Two or three drops of phosphoric acid were further added. The color developed could be matched on a visual colorimeter. Following table shows some analytical results obtained by this method on cereals and pulses.

TABLE 1

Methionine content of some cereals and pulses grown in the Presidency

Cereal	Botanical Name	Protein per cent.	Methionine
1. Ragi (B_{11})	*Eleusine coracana*	4·73	0·28
2. „ (F_{31})	„	5·05	0·26
3. Ragi (A_{16})	„	4·67	0·27
4. Wheat (Bansi)	*Triticum vulgare*	10·47	0·28
5. „ (Motiya)	„	9·60	0·16
6. „ (Niphad)	„	10·41	0·17
7. „ (Gulab)	„	10·35	0·24
8. „ (Jaya)	„	10·43	0·18
9. „ (Vijaya)	„	10·65	0·24
10. Gram (local)	*Cicer arietinum*	16·08	0·13

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March 28, 1946.

R. G. CHITRE.
A. B. KENI.

1. McCarthy, T. E., and Sullivan, M., *J. Biol. Chem.*, 1941, **141**, 871.

THE EFFECT OF CONTINUONS APPLICATION OF FARMYARD MANURE ON THE FERTILITY OF A DEEP BLACK COTTON SOIL

WITH a view to study the effect of continuous application of different organic and inorganic fertilisers on the physico-chemical properties of some important soil-types of the Canal Zones of Bombay Deccan, plot experiments of a permanent nature were laid out at the Padegaon Farm of the Sugarcane Research Station in 1933. Advantage was taken of the opportunity to study the effect of continuous application of farm-yard manure on the fertility of a deep black cotton soil at the end of ten years of experimentation, and a short account of these studies is presented in this note.

The soil used in these studies represents the degraded phase of black cotton soils,[1] and is locally known as "Chopan". The chopan soils are characterised by their alkaline reaction, a zone of accumulation of soluble salts, and the high sodium saturation of their colloidal complex, all of which render them quite unfit for irrigated crops. Since a large portion of the area commanded by the Deccan Canals is covered by the chopan soils their reclamation forms an important item in the Agriculture of the Canal tracts of the Bombay Province. Amongst the soil ammendments commonly used for reclaiming these alkali soils, farm-yard manure alone and in combination with gypsum and sulphur has given promising results.[2] Since in addition to its corrective action the application of the manure is likely to influence the fertility of the soil, it was thought desirable to analyse the different layers of the soil, upto a depth of three feet, at the end of ten years of experimentation and the results of these analyses are summarised in Table I.

It will be seen from the table that as an effect of the application of the manure the soil has gained considerably in all the fertilising elements over both the controls. The extent of enrichment of the soil with different constituents calculated in pounds per acre-foot of the soil over the dry control is much higher than that over the irrigated control, thus bringing out the beneficial effect of irrigation in enhancing the fertility of the soil. Amongst the different fertility factors, it is only the nitrogen status of the soil that is improved to a great extent, the descending order of improvement being:—

Nitrogen > Carbon > Total P_2O_5 > Total K_2O.

It would be of interest to note that although the total potash and phosphate contents of the soil have not improved much, the availability of these two important manurial constituents is raised to a very great extent by the application of farm-yard manure. On the basis of the theoretical quantities of manurial constituents which ought to be present in the soil at the end of ten years the total phosphate of the soil has suffered the maximum loss, and it is followed by nitrogen and potash respectively in descending order. The depth-distribution of different constituents shows that the

TABLE I

Extent of enrichment of the soil (upto a depth of three feet) with different fertility constituents

Constituent	Icrease over irrigated control	Increase over dry control	Losses over irrigated control plus subsequent addition
	pounds	per acre foot	
Nitrogen	2490 (42·02)	2745 (46·84)	— 510 (7·93)
Carbon	29555 (25·04)	35,220 (29·84)	—
Total P_2O_5	1590 (22·69)	1950 (27·84)	— 1415 (16·75)
Total K_2O	1965 (5 ·93)	9760 (29·45)	— 2535 (7·11)
Available P_2O_5	678·65 (54·17)	722·7 (57·68)	—
Available K_2O	4740·5 (67·40)	5375·45 (76· 5)	—

N.B.—Bracketed figures indicate percentage gains over the controls and losses on the theoretical quantities

effect of the application of the manure is confined to the surface 12″-18″ of the soil.

Chemical Laboratory,
Agricultural College,
Poona,
March 16, 1946.

J. K. BASU.
M. M. KIBE.

* This scheme was partly subsidised by the Imperial Council of Agricultural Research.

1. Basu, J. K., and Tagare, V. D., *Ind. Jr. Agri. Sci.*, 1943, **31**, II, 157–81. 2. —, *Agri. Coll. Mag.*, Feb. 1943, **34**, No. 4, 1–4.

A NOTE ON THE REACTION BETWEEN SODIUM CITRATE AND IODINE

ALTHOUGH the reactions of organic acids with halogens have been investigated by many workers, the data on the photocatalytic effect of metallic ions on these reactions available in the literature is scanty. As a preliminary examination of the reaction between sodium citrate and iodine revealed certain interesting features, it was decided to undertake a detailed study of this reaction under varying conditions. Our investigations show that this reaction takes place very slowly in the dark at room temperature (30° C.) leading to a perceptible consumption of iodine only after about 17 hours. An increase in temperature accelerates the reaction to a considerable extent but the speed still remains comparatively a slow one at 40°C. There is no perceptible increase in the speed of the reaction in the light of the tungsten filament lamp. The effect of sun light is also not appreciable. These conclusions are in general agreement with those of Srivastava,[1] except with regard to the influence of temperature, but are in contradiction to the observations of Dhar and co-workers[2,3] according to whom this reaction proceeds with quite a measurable speed even at 23° C. An interesting feature of this reaction is that a small fraction of the amount of iodine is consumed immediately on mixing the solutions of sodium citrate and iodine and thereafter the reaction proceeds very slowly. This indicates that we are dealing here with a complex reaction consisting of two or more reactions one of which takes place rapidly on mixing the solutions.

A quantitative study of the reaction reveals that it does not follow any definite order although towards the later stages it tends to follow the zero-molecular law.

The presence of metallic ions such as $Mn^{\cdot\cdot}$ and $Cr^{\cdot\cdot\cdot}$ is found to accelerate the reaction both in the dark as well as in light, the acceleration due to manganese being much greater than that due to chromium particularly in the dark. It may be mentioned in this connection that Srivastava (*loc. cit.*) failed to notice any effect produced by the presence of $Mn^{\cdot\cdot}$ in this reaction in the dark. This failure on his part may be attributed to the existence of what may be called an induction period, which characterises this reaction as mentioned later on. Comparative experiments employing ions in equimolecular concentrations under the same conditions of experiment show that manganese ions are about ten times more effective than the chromium ions in the dark, but in light, particularly with less concentrations of iodine, chromium exhibits a relative increase in its photo-catalytic activity which tends to approach that of the manganese ions. The reaction in presence of $Mn^{\cdot\cdot}$ both in the dark as well as in light is characterised by the appearance of what may be called an induction period in which the reaction velocity is very slow and does not follow any definite order. On the expiry of this period the reaction gathers speed and follows the zero-molecular law. The reaction in the presence of $Cr^{\cdot\cdot\cdot}$ exhibits this kind of induction only in light but not in the dark. A rise in temperature, exposure to light and an increase in concentration of manganese ions shorten the duration of induction period. Generally speaking the factors which diminish the induction period accelerate the reaction. The temperature coefficient of the reaction in the dark in the presence of $Cr^{\cdot\cdot\cdot}$ and $Mn^{\cdot\cdot}$ is very high, the values lying between 6 and 7, whereas the temperature coefficients of the same reaction in light lie between 1·65 and 2·50. The reaction with $Mn^{\cdot\cdot}$ in light also exhibits an after-effect inasmuch as the reaction is found to proceed for about 45 minutes after the light is cut off with the same velocity as it did when the light was on.

The final product of the reaction in the dark in the presence of both $Mn^{\cdot\cdot}$ and $Cr^{\cdot\cdot\cdot}$ is iodoform

In light and in the presence of Mn", tetra-iodo-acetone is formed (*cf.* Srivastava[4]). In the case of Cr''' in light, only a turbidity is produced without the formation of any solid tetra-iodoacetone. Fuller details of this investigation including a discussion on the mechanism of the reaction under different conditions are being published elsewhere.

M. QURESHI.
K. VEERAIAH.

Central Laboratories for
Scientific and Industrial Research,
Hyderabad (Dn.),
April 22, 1946.

1. Srivastava, *Proc. Indian Science Congress*, 1944, **Part 111**, *Abstracts*, p. 26. 2. Mukerji and Dhar, *J. Indian Chem. Soc.*, 1925, **2**, 277. 3. Bhattacharyya and Dhar, *Ibid.*, 1929, **6**, 451. 4. Srivastava, *Ibid.*, 1945, **22**, 253.

TAMARIND SEED PECTIN

It has already been reported that the tamarind seed pectin is a carbohydrate yielding xylose, glucose, and galactose on complete hydrolysis.[1,2] Damodaran and Rangachari,[3] on the other hand, claim the presence of arabinose and glucose, and this discrepancy they state as "unimportant differences in the analytical results", and attribute it to the non-homogeneous nature of the preparation.[4] With a view to clarifying the point the tamarind seed pectin has been purified by repeated precipitations (eight times), from dilute aqueous solution, by means of alcohol, and analysed at every stage. After the third precipitation, it becomes sufficiently pure and further purification does not materially alter the analytical data. For instance, the figures for the material obtained after the eighth precipitation do not show any appreciable deviation from those of the thrice-precipitated product, namely, $\alpha_D = 71 \cdot 4°$ and pentosan $= 30 \cdot 5$ per cent. At no stage during the analyses of the eight fractions has arabinose been detected, or xylose and galactose missed. It may, however, be pointed out that both nitrogen and phosphorus are not eliminated even in the eighth fraction. It is difficult to say at this stage whether or not they form a part of the molecule.

The presence of xylose has been previously reported on the basis of the formation of the characteristically crystalline osazone melting at 160° and the equally characteristic crystalline cadmium bromide-cadmium xylonate separating in boat-shaped structures.[2] In further support, another characteristic derivative, namely, dibenzylidene dimethyl acetal has now been prepared. When the neutral product of complete hydrolysis is concentrated to a syrupy consistency on a water-bath, dried in a vacuum desiccator for a number of days and afterwards treated with a methyl alcoholic solution of benzaldehyde in the presence of hydrogen chloride, the crystalline derivative melting at 211° gradually separates out. Amongst the ordinary hexoses and pentoses including arabinose, xylose alone gives this derivative.[5]

The findings of Savur and Sreenivasan[6] are in general agreement with ours except the following. In their studies on complete hydrolysis of the pectin by boiling with 3 per cent. sulphuric acid for 8 hours they obtain reducing sugars to an extent of $41 \cdot 5$ per cent., while Damodaran and Rangachari have found 83 per cent. under similar conditions. For the complete hydrolysis we have employed boiling 5 per cent. sulphuric acid for 4 hours, and when calculated on the basis of pure anhydrous pectin, the yield of the reducing sugars (expressed as glucose) amounts to $106 \cdot 8$ per cent. Further, from our studies on specific rotation of the hydrolysate, which varies from 52° to 54°, we have tentatively fixed the ratio of the constituent sugars as 1:1:1, whereas Sreenivasan and Savur[6] report xylose 2, galactose 1 and glucose 3.

It has been suggested that the pectic substance from the tamarind seeds is a mucilage.[3,4] It may be pointed out that there is not much resemblance between the two substances either in essential chemical composition or in characteristic physical properties; mucilages are not known to form any acid-sugar jellies. Gums, mucilages and pectins cannot be readily distinguished from a study of their chemical composition alone; physical properties go a long way in differentiating one group from the other.

Forest Research Institute,
Dehra Dun,
March 9, 1946.

P. S. RAO.
S. KRISHNA.

1. Ghose and Krishna, *Curr. Sci.*, 1945, **14**, 299. 2. Ghose, Krishna and Suryaprakasa Rao, *Jour. Sci. & Ind. Res.*, 1946, **5**. 3. Damodaran and Rangachari, *Curr. Sci.*, 1945, **14**, 203. 4. —, *Ibid.*, 1946, **15**, 20. 5. Breddy and Jones, *Journ. Chem. Sci.*, 1945, 738. 6. Savur and Sreenivasan, *Curr. Sci.*, 1946, **15**, 43.

COMMENT ON NOTE ON "TAMARIND SEED PECTIN"

No further work has been done in this Laboratory on tamarind seed "pectin" after the publication of our previous note,[1] as our interest was in genuine pectin. However some of the statements in the present note by Rao and Krishna call for comment. These authors as well as Savur and Srinivasan[2] are of opinion that their observations in regard to the material prepared from tamarind seed are mutually in agreement and differ from our findings. However, the tabulated statement given below of the results obtained in the three laboratories does not in the least bear out this view.

An examination of Table I fails to reveal the alleged similarity in the results of the Dehra Dun and the Bombay investigators. *All* the results are in agreement in showing (*i*) that the substance gives no calcium pectate according to Carré and Haynes method, (*ii*) that it yields no galacturonic acid on hydrolysis but a mixture of hexose and pentose and (*iii*) that the methoxyl and uronic acid values are *low*. This is conclusive proof that tamarind seed contains no pectin inasmuch as pectins are now known to be partially methylated polygalacturonic acids and are estimated quantitatively by determination of the yield of calcium salt of the demethylated polygalacturonic acid.

TABLE I

	Damodaran and Rangachari[1]	Ghose and Krishna[3] Rao and Krishna	Nanji *et al.*[4] Savur and Srinivasan[2]
1. Calcium pectate number	0·0	Not reported	0·0
2. Methoxyl %	1·08	0·0	0·0
3. Uronic acid (%)	12·59	0·0	3·44
Products of acid hydrolysis			
4. Galacturonic acid	Not obtained	Not obtained	Not obtained
5. Yield of reducing sugars (%)	83·0	106·8	41·5
6. Sugars identified	Glucose, Arabinose	Glucose, Galactose Xylose	Glucose Galactose Xylose
7. Relative proportion of sugars	Hexose : Pentose = 53 : 33	Glucose. Galactose: Xylose = 33 : 33. 33	Glucose · Galactose : Xylose= 55: 16. 28

With regard to other analytical details, namely, the percentage of methoxyl and uronic acid, the nature and yield of sugars on hydrolysis, the relative proportions of hexoses and pentoses, etc., there are wide discrepancies between the three sets of results. But, as we have stated before, for establishing the presence or absence of pectin, these discrepancies are of no importance. Furthermore they are unavoidable with the kind of preparations that have been studied. The product examined by us in this Laboratory was obtained according to the original method of Ghose and Krishna.[5] Savur and Srinivasan[2] have analysed a "purified" preparation while Ghose and Krishna[3] and Rao and Krishna have studied a preparation obtained by a modified method. The relation of these purified and modified preparations to the original "pectin" claimed to have been isolated by Ghose and Krishna[5] in 60 per cent. yield is not at all clear There is no doubt that we are dealing with a mixture as is convincingly shown by the divergences in the analytical data. With such a mixture purification or modification of the method of preparation would inevitably lead to fractionation yielding preparations in which all the polysaccharides—and therefore the component sugars—originally present in the crude substance are not necessarily found. Nor is it surprising that Savur and Srinivasan[2] could not find arabinose in a hydrolysate in which over 60 per cent. of the sugars present was destroyed during the process of hydrolysis. In justification of the low yield of sugar obtained by them these authors have quoted the experience of Buston and Chambers.[6] Reference to the paper mentioned shows, however, that Buston and Chambers observed a destruction of sugar amounting only to about 10 per cent. Similarly it will be found on reference to our note[1] on tamarind seed "pectin" that no claim was made as is implied by Savur and Srinivasan and by Ghose and Krishna that identification of the sugars was complete. The ratio of hexose to pentose was determined by quantitative methods quite independent of the identity of the sugars present and was, for our purpose, quite conclusive.

Finally we are at a complete loss to understand the objection of Rao and Krishna to the name mucilage. It is an accepted fact that pectins are mucilages of a special type—take for example, the following sentence from Harrow and Sherwin, *Text-Book of Biochemistry*[7]: "The pectins belong to the vegetable mucileges which are carbohydrate in character and widely distributed in nature." The product obtained from tamarind seed by Ghose and Krishna is an interesting substance because it possesses the useful physical property of pectin of forming sugar acid jellies without the chemical make-up characteristic of pectin. It will be interesting to know the chemical constitution of the jelly-forming constituent of tamarind seed mucilage *after* it has been isolated in a state of proved homogeneity.

M. DAMODARAN.
P. N. RANGACHARI.

University Biochemical
Laboratory, Madras,
April 11, 1946.

1. Damodaran and Rangachari, *Curr. Sci.*, 1945, **14**, 203. 2. Savur and Srinivasan, *Ibid.*, 1946, **15**, **43**. 3. Ghose and Krishna, *Ibid.*, 1945, **14**, 299. 4. Nanji *et al.*, *Ibid.*, 1945, **14**, 129. 5. Ghose and Krishna, *Jour. Ind. Chem. Soc*, *Ind. and News Edn.*, 1942, **5**, 114. 6. Buston and Chambers, *Biochem. Jour.*, 1933, **27**, 1691. 7. Harrow and Sherwin, *Text book of Biochemistry*, W. B. Saunders Co., London, 1935.

TAMARIND SEED PECTIN

WE are in general agreement with the observations reported by Rao and Krishna except in regard to para 3 and we should, therefore, like to bring out the following points:—

Our tentative conclusion[1] that the molecular proportion of the constituent sugars in purified tamarind seed 'pectin' is 2 xylose: 1 galactose: 3 glucose was based on studies in the yields of furfural on distillation with dilute acid and of mucic and saccharic acids on oxidation with nitric acid. This was considered to be the only reliable method for ascertaining the ratios of the sugars. Prolonged acid hydrolysis has been definitely shown to result in a partial destruction of reducing sugars[1] while, in making calculations from studies on specific rotation of the hydrolysate, it frequently happens that small experimental errors are enormously magnified so that the final results, even with mixtures of pure sugars, can be regarded as only very roughly approximate.[2]

These and related observations are discussed

more fully in a paper to be published elsewhere.

G. R. SAVUR.
A. SREENIVASAN.

Dept. of Chemical Technology,
Bombay University,
April 17, 1946.

1. Savur and Sreenivasan, *Curr. Sci.*, 1946, **15**, 43.
2. Browne and Zerban, *Physical and Chemical Methods of Sugar Analysis*, John Wiley and Sons, New York, Third Edition, 1941, p. 986.

AN EFFECTIVE AND INEXPENSIVE METHOD FOR THE CONTROL OF STEM-BORERS IN FRUITTREES, WITH SPECIAL REFERENCE TO *SANTRA* TREES IN C.P. AND BERAR

THIS work was originally started in the year 1941 in connection with the control of the destructive action of *Indrabela quadrinotata* (popularly known amongst the C.P. orchardists as *jaliwala kida*) on *santra* (*Citrus suntara* Engl.) cultivation in the Central Provinces and Berar.

These stem-borers (caterpillars of *Indrabela quadrinotata*) bore holes through the live bark of the tree and come to reside safely in tunnels, often lybarenthine, carved out by them inside the wood. And it is only during night that they emerge from their abode and gnaw the live bark from day to day. The transport of the elaborated food material in consequence is hindered adversely and ultimately the tree succumbs to a slow death within a period of five to six years. Orchards after orchards have thus been wiped off causing considerable economic loss to the cultivator.

A number of treatments (*e.g.*, chloroform. chlorosol, petrol and kerosene oil) commonly recommended by entomologists were given concerted trials. But they did not prove wholly satisfactory and besides, the cost of treatment was prohibitive.

After numerous experimentations and trials since 1941, I have been able to find out a most effective and inexpensive method to control the ravages of this deadly stem-borer on *santra* trees. My method simply consists in introducing hot-water through the external hole or opening leading to the abode of the stem-borer, by means of an ordinary tin-syringe (*pitchkari*) so very commonly used by young folks during the *Holi* festival for throwing or spraying coloured water. Care should be taken to flood the inside of the tunnel fully by a liberal application of hot water. The holes so treated are then plugged the following day with cement or with ordinary clay mixed with cowdung.

This treatment, since its discovery in 1943, has been widely applied with effective success in several *santra* orchards in C.P. and Berar and also in the Bhopal State (C.I.); and the same has been extended with remarkable success to control the ravages of stem-borers in mango, jack, *jamoon*, *ber* and guava. And I dare say that the treatment could universally be employed with success for the control of stem-borers on any tree including even timber.

My grateful thanks are due to Professor T. C. N. Singh for the energetic interest he has taken in giving this method demonstrative trials in several orchards.

Horticultural Research Institute,
Nagpur-Ajni,
March 3, 1946.
(MISS) R. SHAH.

TWO VARIETIES OF *TACHARDINA LOBATA*

GREEN'S work on the Coccids of Ceylon gives illustrations of his *Tachardia minuta*. As previously[1] explained his illustrations are the result of a confusion between two distinct species now named *Tachardina lobata*, which is the latest name for *T. minuta* and *Tachardina Silvestrii*, so far not recognised by others. However, *T. Silvestrii* has two symbiotes of which the more predominant one was discovered and illustrated by me.[2] Dr. Walczuch made a cytological study of this insect and found another micro-organism which had escaped my observation. She illustrates both these symbiotes in her thesis.[3]

The organism discovered by me as the symbiote of *T. Silvestrii* was cultivated long ago.[4] At that time the literature was full of yeast like micro-organisms being in symbiosis with insects. Dominated with such ideas the symbiote of *T. Silvestrii* was called a Nocardia, instead of a bacterium, the mycotic genus Nocardia being the nearest approach morphologically to a bacterium.

Tachardina lobata has a symbiote which resembles a species of coccus bacterium. This was also cultivated. At first it was considered a species of yeast and was classed accordingly as an *Atelosaccharomyces* sp. Later it was imagined to be a Torula[2] still under the influence of the special literature on symbiosis. Dr. Walczuch also studied *T. lobata* and illustrates its symbiote giving the same picture as that reproduced by me. But she had kindly shown me some of her slides where the micro-organism appeared different and I imagine Buchner's latest edition[5] of his classical work on Symbiosis has one such illustration by Walczuch. Fig. 1 here gives the symbiote of *T. lobata* as previously illustrated by me, Fig. 1 "M"; which is confirmed by Walczuch, reproduced as Fig. 1 "W". There is no difference between these two typical illustrations. But the picture shown in Fig. 1 "L" is strikingly different and these were the symbiotes that I first saw in some of the slides of Dr. Walczuch. It was discussed but the conclusion was reached that the organism showed polymorphism. This was the natural conclusion when the same insect was supposed to have these symbiotes.

My subsequent work on the isolation of symbiotic micro-organisms had made me sceptical about this hypothetical polymorphism. In 1940 when I went to Bangalore I repeated the entire work. *T. Silvestrii* showed the two micro-organisms; both were cultured and found to be different from each other and thus the work of Walczuch was confirmed.

My illustrations of the symbiote of *T. lobata* were derived from insects growing on *Michelia champaca*. These trees were still found in the estates of the Indian Institute of Science and the shape of the micro-organism was confirmed even when cultivated. The same insect was also found growing on *Pongamia glabra* and gave the identical result. But some trees of *Guazuma tomentosa*, found in the compound of the Chief Secretariat, Bangalore, gave insects whose blood smears had symbiotes shown as Fig. 1 "L". These were also cultured and shown to be different. The symbiotes of *T. Silvestrii* were both bacteria and the symbiotes of *T. lobata* on *Michelia champaca* and on *Guazuma tomentosa* were also bacteria and both different from each other.

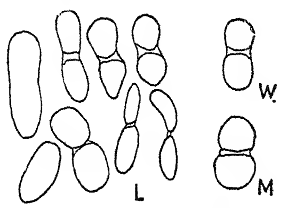


FIG. 1. Symbiotes of *Tachardina lobata*. "M" previously illustrated by Mahdihassan and "W" as confirmed by Walczuch, both M and W belong to the variety *T. Lobata Schmidtii*. The symbiotic picture "L" is given by *T. Lobata var. Walczuchii*.

T. Silvestrii can be distinguished from *T. lobata* in the living condition by a glance. In the dried condition a solution in alcohol of the secretion of *T. Silvestrii* is yellow while the secretion of *T. lobata* is purple, like their colours as illustrated before.[2] The insects now found on *Michelia champaca* and on *Guazuma tomentosa* could not be separated but by their blood smears; from every other point they were identical and both had to be named *T. lobata*. The lac insect of Kashmir, *Lakshadia ficii* has yellow and red forms so is the case with the Ceylonese insect, *L. albizziæ*. The symbiotes of these yellow and red insects do not show any difference between them. With the varieties of *T. lobata* the symbiotes were different, while their secretion remained the same, both kinds of insects producing the same purple colour.

After some search *Pongamia glabra* was found to have *T. lobata* with round bacterium in its blood smears (Fig. 1 "M" and "W"). Another branch of this tree was infected with brood derived from Guazuma tomentosa. That was done in 1940; when I went to Bangalore in 1941 both these varieties of *T. lobata* were found growing on two different branches of the same tree. The blood smears showed both these insects to be different from each other, leaving no doubt that the food plant had no effect whatsoever. I have previously[1] given a list of trees on which *T. lobata* has been found and this list now needs a revision in the light of what has been said above. It is possible that both the varieties might take to the host-plants mentioned before but experimental inoculation has to be carried out.

But for Dr. Walczuch I should not have known the varieties, hence the variety with symbiotes shown as Fig. 1 "L" is being named *Tachardina lobata Walczuchii* and the former insect, with the symbiotic picture given in Fig. 1 "M" and "W", as *T. lobata Schmidtii*, after Prof. W. J. Schmidt, of Giessen, under whom I also worked on lac and first confirmed the finding of Walczuch. There is no meaning in naming one insect *T. lobata* and the other *T. lobata variety Walczuchii*, for one is as much a variety of the other. Mere museum-specimens cannot but be simply called *T. lobata*, which might mean one or the other variety; cytologically and by blood smears the varieties can be easily distinguished.

Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
April 16, 1946.

1. *Archiv für Naturgeschichte*, 1936, **5**, 1–22. 2. *Archiv für Protistenkunde*, 1928, **63**, 20. 3. *Zeit. für Morph. u. Ökologie*, 1932, **25**, 630. 4. *Some Studies in Biochemistry*—a Dedication to Dr. G. J. Fowler, Bangalore, 1924, p. 187. 5. *Tier und Pflanze in intrazellular Symbiose*, 1930.

THE CHINESE ORIGIN OF THE WORD CHEMISTRY

CHEMISTRY, in German and French, is merely Chemie, while in Arabic it is Alkimia, the word alchemy, the supposed science of converting base metals into gold. There is a Latin and even an earlier Greek form, Kemia, as given by Platts, in his *Dictionary of Urdu, Classical Hindi and English*, 1911, page 890. The enquiry is thus shifted to Greek which probably represents the earliest mention of the word in the above-named languages. But the question is, what does the word Kemia or Chimea connote, be it Greek?

In my other communications, which are to appear in the *Osmania University Research Journal*, I have shown how important it is to apply a synthetic method of giving probable meanings to words, at present signifying nothing, and coining synonyms which would express the sense. Alchemy, or even its purer Arabic form, means the art or science of making gold. I imagine the Greek word does the same. All these names are primarily associated with the idea of gold. The Chinese word for gold is *Chin*, character No. 2032, in the *Chinese Dictionary* of Giles, 1892. It is pronounced as *Kem* in the Cantonese dialect and as *Kim* in the Hakka dialect, also of southern China. *Mi* is character No. 7809; Giles translates it as "to go astray, fascinated, infatuated" and gives the term *Ts'ai-Mi* which he renders as "Mad on making money; avaricuous". This I consider is a paraphrase rather than a translation but has to be respected as the attempt of a savant. Similarly *Chin-Mi* would be translated as "Mad on making gold" in the style of Giles, while a more realistic rendering would signify "Bewitched with the idea of making gold; gone astray in believing that gold can be made." These would be translations where the sense of the original Chinese

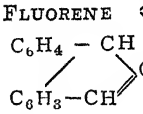
text is well preserved, although the English here suffers in quality. The word *Mi*, of the classical Chinese, is also pronounced *Mi* in Hakka, while in Cantonese it is *Mai*. The Cantonese term *Kem-Mai* and the Hakka term *Kim-Mi*, particularly the latter, seem to be the origin of derivatives like Kemia the Greek, Chemie the French, and Alchemy the Arabic word.

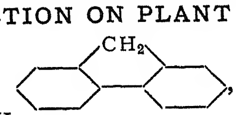
The Chinese are shrewd observers. In their term *Kim-Mi* they have expressed exactly what alchemy is. It is not the art or the science of making gold. What can be observed and easily verified is the misplaced enthusiasm of the alchemist, his bewitchment rather than his achievement. There being no science of gold making such a name would be a misnomer, so the Chinese, with their love for realism, have expressed, by their term *Kim-Mi*, the psychology of some people. Bewitchment for gold is not madness for gold, the latter is something like a caricature in words of the former expression, and to make the subtle difference between them gives much credit to the Chinese mind. Madness for gold exaggerates facts and conveys something ridiculous, while bewitchment for gold leads one to a tragic end, which is implicitly expressed in the Chinese name. Of all the terms for alchemy, the Chinese term *Kim-Mi* is the most real expression.

Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
April 20, 1946.

CHEMICAL STRUCTURE IN RELATION TO ACTION ON PLANT NUCLEUS

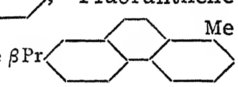
FLUORENE





, Fluoranthene

and Retene



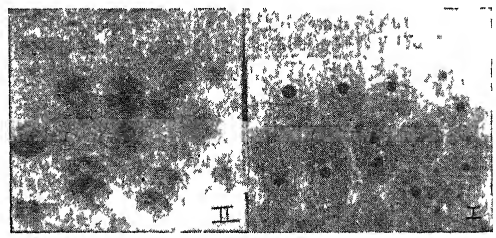
were used to treat seeds with a view to correlate molecular structure and action on plant nucleus. These were made into 5 per cent. solutions in lard and seeds were soaked in these pastes for different periods. Three types of seeds were used: (*a*) *Cajanus indicus* (Spreng) which has a thick seed coat, (*b*) *Triticum vulgare*, pure strain I.P. 165 with a thin seed coat, (*c*) *Cucurbita maxima*, in which the seed coat was artificially removed. The treated seeds were soaked, sprouted, and root tips used for cytological study. Some wheat was grown to maturity. It was found that the treated material could be grown to healthy plants. The germination percentage was almost normal for *Triticum* and *Cajanus* seeds treated for 20 days. Prolonging the treatment reduced germination percentage.

Genetic effects.—The plants from treated wheat seeds closely resembled the control plants except in one feature, namely, in 5 out of 50 plants the pollen grains were larger. The normal pollen diameter was a constant 56 μ at dehiscence stage and in the new type about 60 to 62 μ.

Cytological effects.—Treatment lasting 20 or more days generally produced cytological changes. The most apparent was in the nucleolii, their number being increased as below (Fig. 2).

Plant	Normal	Treated roots
Triticum	1 or 2	2 to 4
Cajanus	1	2
Cucurbita	1	2 to 3

In some *Cajanus* and *Cucurbita* material some binucleate cells were produced, possibly by temporary inhibition of cell wall (Fig. 1).



I. Binucleate cell in *Cajanus*. II. Multiple nucleoli in wheat.

There were other changes in chromosome behaviour and plane of cell division, and these are being analysed. There was no clear evidence of the chromosome number being increased.

There was not much difference between the chemicals in their action, but retene seems to be the most effective. The expectation that the hydrocarbons would pass into the cells in a fatty solvent, and later affect the nucleus appears to be confirmed. It is probable that chemicals more akin to the carcinogenic hydrocarbons, benzpyrene and cholanthrene, and their homologues, would be more potent when applied similarly. We wish to acknowledge the help and encouragement given by Principal V. K. Badami, Ph.D. (Cantab.), in connection with this work.

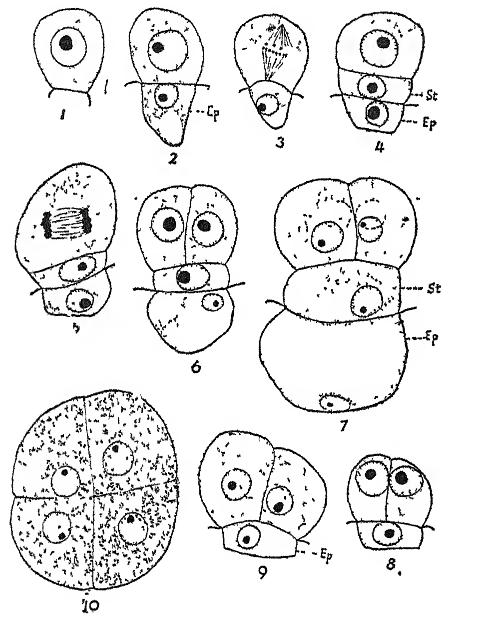
S. SAMPATH.
S. S. RAJAN.
S. P. SINGH.
College of Agricultural Research,
Benares Hindu University,
April 11, 1946.

GLANDULAR TRICHOMES ON THE OVULES OF *LEONURUS SIBIRICUS* LINN.

THE occurrence of glandular trichomes on the various parts of the plant-body is characteristic of Labiates. In some species they occur even on the external surface of the ovules. A developmental study of the trichomes on the ovules of *Leonurus sibiricus* Linn. is presented

here in view of its bearing on the classification of these structures in the family Labiatæ (Schnarf, 1917).

The initiation of a trichome is seen by the bulging of an epidermal cell and is noted before syngamy, the stimulus of fertilisation being responsible for their greater production. The epidermal cell divides transversely to form a basal cell which remains epidermal and an upper cell (Figs. 1-2). The latter again divides transversely to form a stalk cell and the apical primary gland cell which by two vertical divisions gives rise to a typical four-celled glandular structure with a rectangular stalk cell below (Figs. 3-7). The vertical divisions may, however, be initiated on the upper cell resulting from the first division of the epidermal cell, so that sessile gland results (Figs. 8-9). Occasionally oblique divisions have been found to occur.



Leonurus sibiricus L. FIGS. 1-7. Stages in the development of stalked glands (×1600). FIGS. 8-9. Stages in the development of sessile glends. (×1600). FIG. 10. Top view of a mature four-celled gland (×1600). *Ep*= Epidermal cell. *St*=Stalk cell.

As the ovule grows in size both longitudinally as well as laterally, the sides of the glands gradually approximate the adjacent ovarian wall, the result being that the innumerable glands have a compressed appearance. These glandular organs are, however, absent around the micropylar part of the ovule.

Schnarf (1917) distinguished two types of glandular trichomes which occur on the external surface of the ovules, *viz.*, *"Lamium* type" which are sessile, usually consists of four cells and develop after fertilisation, and the *"Scutellaria type"*, which are stalked, multicellular and disc-shaped, and develop before fertilisation. The trichomes of *Leonurus sibiricus* resemble the *"Lamium* type" in the sessile and four-celled nature and the *"Scutellaria* type" in having a stalk and developing before fertilisation. Junell (1937) refers the trichomes of *Leonurus cardiaca* to the *"Lamium* type" as they appear after fertilisation and though he anomalously includes the stalked glands of *Physostegia virginiana* in *"Lamium* type" he states again that it can possibly be included in *"Scutellaria* type" as they appear before fertilisation. Thus the rigidity of the use of characters like the presence or absence of a stalk or the appearance before or after fertilisation as employed by Schnarf (1917), cannot be maintained in the light of the present observations in *Leonurus sibiricus* and that of Junell's (1937) in *Physostegia virginiana*. It is better to distinguish them only on the basis of the complexity of structure as 'simple' (1-4-celled) or 'multicellular and disc-like' glands.

My thanks are due to Dr. I. Banerji for the interest taken in the work.

JAYANTA KUMAR GANGULY.
Department of Botany,
Calcutta University,
December 22, 1945.

1. Junell, "Die Samenentwicklung beieiningen Labiaten L.," *Sartryck ur Svensk Botanisk Tidskrift*-1937, **Bd. 31**, 67–100. 2. Schnarf "Beitrage Zur Kenntni, der Samenentwicklung der Labiaten," *Denkschr. Akads Wiss. Wien. Math. Nat. Kl.*, 1917, No. 126.

BIOLOGICAL NOTES ON *PLEUROTROPIS FOVEOLATUS* CRAWFORD—A LARVAL PARASITE OF *EPILACHNA VIGINTIOCTO-PUNCTATA* FAB.

Pleurotropis foveolatus, first described by Crawford (1912) from specimen forwarded by Dr. Coleman of Mysore, and recorded by Ayyar (1921) and Krishnamurti (1932) in South India, was observed in Bihar (1940) while combating *Epilachna Vigintioctopunctata* which is a serious pest on vegetables such as potato, tomato, brinjal and cucurbits. Since the details regarding the biology and life-history of this chalcidoid parasite are not known, the following brief notes are recorded:—

The fourth instar larvæ are parasitised by the female parasite, which punctures the host dorsolaterally for depositing her eggs. The process lasts for 15-20 minutes and each female can handle 8-10 larvæ, before her death. The parasitised larvæ turn brown, become sluggish, scarcely feed and fail to pupate and die in 5-6 days. They are usually observed sticking to the under-surface of the leaf between July and February and to the stem of the plant during March to June. Fifteen to twenty parasites have been recovered from each parasitised larva collected in the field.

The parasite-egg is smooth, shiny and transparent when fresh; it is spindle-shaped, the narrow half being curved. The period of incubation lasts from 24-28 hours in summer, and 48-72 hours in winter. The parasite larva is white, transparent and curved on hatching and turns yellowish as it feeds on the host. The full-grown larvæ are slightly curved, gently taper towards both ends and remain attached to one another. The larval period ranges between 7-8 days in summer and 14-15 days in winter. Pupation takes place within the host's body the pupal period ranging from 3-4 days in summer and 10-12 days in winter.

The adult parasites emerge out through irregular holes nibbled in the body skin of the host and mate soon afterwards, the process occupying, on the average, about 30 seconds. The average number of eggs laid by a female is 24·8, the maximum being 50. The female may parasitise more than one host and live for 10 days; while the male could live up to 8 days.

Eighteen broods of the parasite were observed in a year under laboratory conditions. The other important host for the parasite is *Epilachna dodecastigma*. The parasite is commonly seen in the field all round the year but from December to January and from March to June it becomes scarce. The population of the parasite as well as its host is reduced due to adverse temperature conditions during these periods.

Krishnamurti (1932) has observed at Bangalore that the percentage of parasitism has never exceeded 5 to 8. The following figures will show that in Bihar the percentage of parasitisation exceeds 10 during 8 months of the year and reaches the maximum of 16·9 in October.

TABLE I

Showing the extent of parasitism in the larvæ of Epilachna Vigintiocto-punctata

Months	Total number of larvæ collected	No. of parasitised larvæ	Percentage of parasitism
July	76	10	13·1
August	238	30	12·6
September	108	13	12·0
October	71	12	16·9
November	112	15	13·3
December	78	8	10·2
January	59	6	10·1
February	116	13	11·2
March	91	4	4·3
April	64	2	3·1
May	57	2	3·5
June	68	4	5·8

The writer is much indebted to Dr. M. L. Bhatia, *ex*-Entomologist, Department of Agriculture, Bihar, Sabour, for suggesting the problem and giving generous help and guidance.

Entomological Section,
Bihar Agricultural College,
Sabour, B. LAL.
February 13, 1946.

1. Crawford, J. C., *Proc. U.S.N. Mus.*, 1912, **42**, 7. 2. Ayyar, T. V. R., *Rept. Proc. Fourth Entom. Mtg. Pusa*, 1921, 365. 3. Krishnamurti, B. *Entom. Ser. Bull. No.* 9, *Dept. Agric. Mysore. State*, 1932. 4 Hem Singh Pruthi and Mani, M. S., *Miscellaneous Bull No.* 30, 1940, p. 25, *I.C.A.R.*, *New Delhi*.

SOME NOTES ON THE EMBRYO OF *CYMBIDIUM BICOLOR* LINDL.

THE two-celled proembryo of *Cymbidium bicolor* gives rise to an irregular mass of 5 to 10 cells; a cell situated towards the chalazal end of and belonging to this mass develops into a filamentous unicellular row of 6 to 10 cells; 2 or 3 terminal cells of this filament by further divisions form the actual embryonal mass. This course of development has been described in detail as the normal method for the embryo of *C. bicolor* (Swamy, 1942). During a re-examination of the slides two very interesting features were met with, which have been described blow:

(1) The zygote gives rise to an irregular mass of cells as has been said above. Hand in hand with this the cells of the inner integument become disintegrated so that there is free scope for the suspensor cells to expand in every direction. Even the filamentous proembryo develops not inside the cavity of the embryo-sac but in the empty space within the outer integument, so that the embryo may be said to develop outside the embryo-sac. While the suspensor cells elongate they do so by pushing through the disintegrating tissue and grow out into the space outside the embryo-sac. The embryo-sac with the degenerating primary endosperm nucleus may be seen below the developing embryo (Fig. 1).

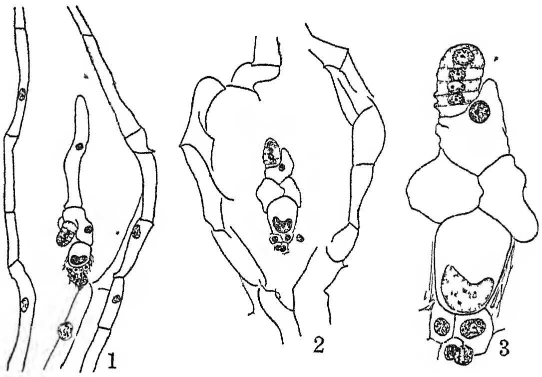


FIG. 1. L. s. of an ovule showing the proembryo developing outside the cavity of the-embryo-sac; the degenerating primary endosperm nucleus may be seen inside the embryo-sac, × 80.

FIG. 2. L. s. of an ovule in which "inverted polarity" of the embryo is noticed, × 80.

FIG. 3. Embryo and its surrounding structures enlarged from Fig. 2, × 200

All figures are shown as the micropyle pointing away from the observer.

(2) A more interesting instance is what may be described as the "Inverted polarity of the embryo". It is a well-known feature that the radicle end of the embryo in the seed is directed towards the micropyle and the plumule towards the chalaza. This character can be universally and clearly demonstrated during the early stages of the embryonomy itself. In contradistinction to the normal disposition, in the present instance the filamentous proembryo was seen developing towards the micropylar end. The suspensor cells were as usual abutting the micropylar end of the embryo-sac (Figs. 2 and 3). Evidently here the prosuspensor cells may be assumed to have been formed in the characteristic method described for the species, but the filamentous proembryo, instead of developing from a cell situated towards the chalazal end, has developed from a cell situated towards the micropylar end of the irregular mass of cells. It could not be

determined, however, whether such "inverted" proembryo develops to maturity in the same disposition or whether the filamentous region curves down towards the chalaza during subsequent stages so that the fully formed embryo assumes the normal position.

The present author has not been able to verify if parallel instances have been recorded in literature. However, both kinds of abnormalities described at presnt are extremely rare among spermatophytes. The first kind of anomaly is noticed in more than 90 per cent. of the ovules of *C. bicolor*. The second kind, on the other hand, was seen only in two ovules, in each of which the embryo was in more or less the same stage of development.

Basavangudi,
Bangalore, B. G. L. SWAMY.
April 20, 1946.

Swamy, B. G L., *Proc. Ind. Acad. Sci.*, B, 1942, **15**, 194–201.

ON A NEW SPECIES OF *ISACCOCIRRUS* FROM THE MADRAS BEACH

THREE species of *Saccocirrus* have been recorded from the Indian coast; *S. minor* and *S. cirratus* from the Madras beach (Aiyar and Alikunhi, 1944), and *S. krusadensis* from the Gulf of Manaar (Alikunhi, 1942). The present form, also from the Madras beach, is the next to be added to the genus from India and forms the subject-matter for this communication.

The worms occur in the inter-tidal zone but rarely; and each measuring 10 to 12 mm. in length, is pale white in colour. Segmentation is distinct, the number of segments varying from 50 to 70. The body gradually tapers to the hind end. The head is bluntly conical and has a pair of dark eyes and two long tentacles which have a pointed appearance owing to numerous constrictions (Fig. 1*a*). The nuchal organs are conspicuous, each in the form of an oval, richly ciliated depression narrowing abruptly to the outer border. Palpocils are few on the prostomium, tentacles and body-surface. Hypodermal glands are well developed. Examined in the fresh condition (without a coverslip) a prominent group of these glands is seen on either side in every segment. The last six or seven segments of the body are apodous and achætous. The pygidium is bifurcated; anal lobes are long, each provided with four to six adhesive pad-like pupillæ on its ventro-median aspect (Fig. 1*b*). Rod-shaped hypodermal glands are crowded on each papilla. Palpocils are numerous on the pygidial lobes. Each parapodium carries a bundle of eight or nine capillary bristles, all of which have their tips smooth and variously expanded.

The ampullæ of the head-cavity extend into the first setigerous segment. A conspicuous muscular pad is absent in the pharyngeal wall. Gonads are usually developed from the 18th or 20th segment backwards. In the male the sperms are slender and exhibit movement when pressed out. The arrangement of the nephridia, sperm-sacs and penes is similar to that in *S. minor*. The penis is thick-walled and supported by cuticular rods.

The present form differs from *S. minor* in the jointed appearance of the cephalic tentacles and in the bifurcated pygidium. It differs from *S. cirratus* in its smaller size and in the absence of anal cirri and the pharyngeal muscular pad; and from *S. krusadensis* in the

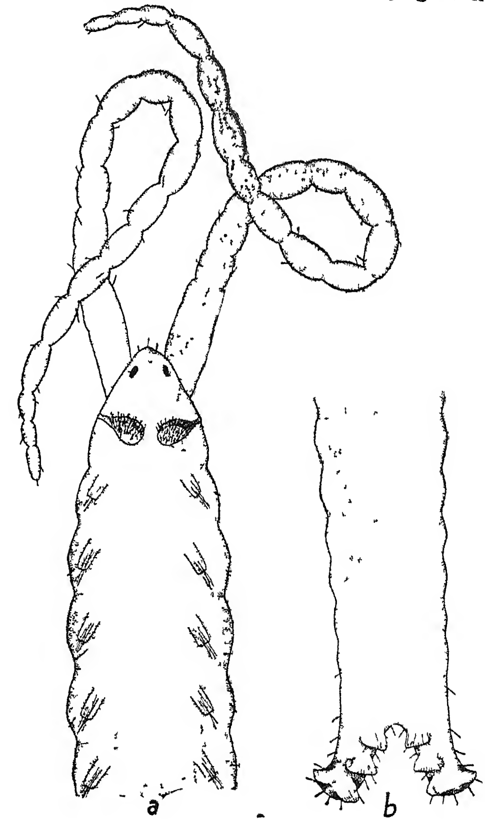


FIG. 1

Saccocirrus Orientalis, n. sp., Cephalic and pygicial ends. a. × 54; b. ×90.

nature of the setæ besides the poorly developed pharyngeal musculature. The structure of the pygidium is very much similar to that in *S. papillocercus*, but in the nature of the setæ, pharyngeal musculature and size it closely resembles *S. minor*. It could be distinguished from all the known species of the genus by its peculiar smooth-tipped bristles, together with the bifurcated pygidium provided with anal lobes. It thus appears to be undescribed and I assign it to a new species under the name *Saccocirrus orientalis*.

My thanks are due to Prof. R. Gopala Aiyar and Prof. P. Narayana Menon for the kind help they extended to me.

Zoology Laboratory, Madras,
and
Dept. of Natural Science,
Maharaja's College,
Ernakulam, K. H. ALIKUNHI.
September 1, 1945.

1. Aiyar, R. G., and Alikunhi, K. H., "On Some Arcniahnelids of the Madras Coast," *Proc. Nat. Inst. Sci. India.*, **1944**, **10**, No. 1. 2. Alikunhi, K. H., "Note on the occurrence of Archiannelids at Krusadai together with a description of an undescribed species of *Saccocirrus*", *Proc. Ind. Sci. Congr.*, 1942, 29th Session, Benares.

NOTES ON THE ANATOMY OF *HEMIONITIS ARIFOLIA* (BUR.) BEDD.

The genus *Hemionitis*, one of the Polypodiaceæ, is represented in India, according to Beddome (1892, *Ferns of British India*, p. 414) by a single species *H. arifolia*, which occurs abundantly in South India and eastern Bengal. The species is a xerophyte and grows between rock crevices or as an epiphyte on tree trunks, the rhizome lying buried inside the humus on the bark and its crevices. No detailed description of this plant is available in any of the standard books on ferns. It was, therefore, thought that a comprehensive investigation of its life-history and anatomy would be interesting and profitable. The present note embodies the preliminary observations of such a study.

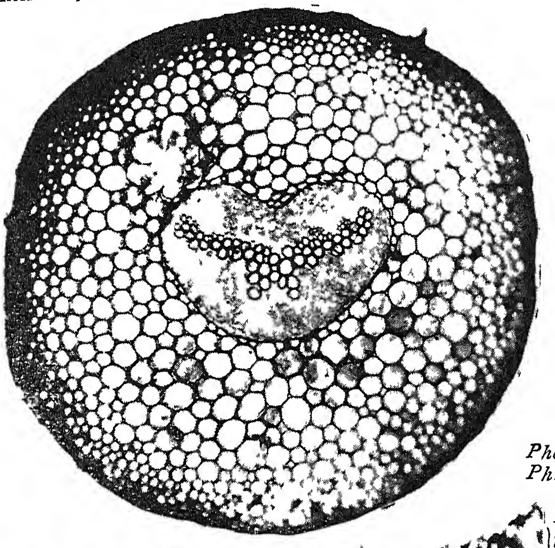


Photo 1 × 28¾
Photo 2 × 32

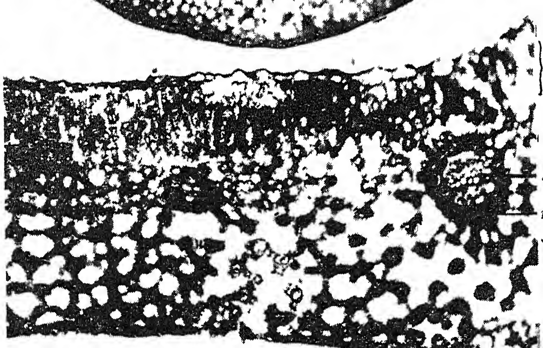
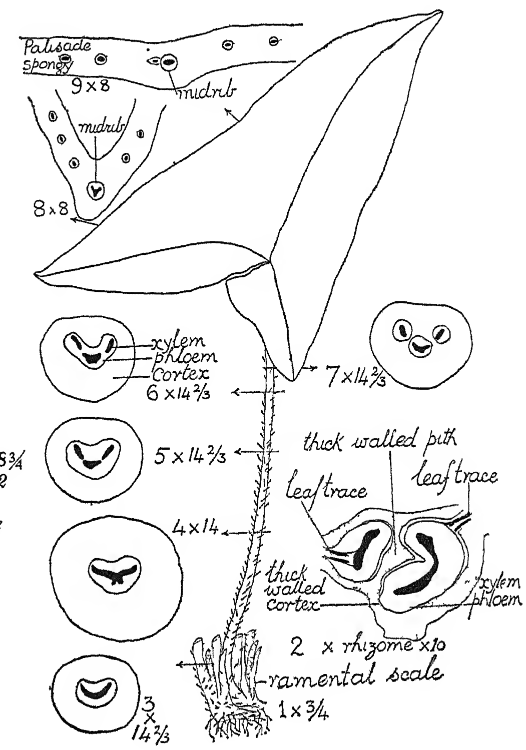


Photo. 1 Transverse section of petiole showing the x shaped xylem. Photo. 2. Transverse section of lamina showing the midrib, the palisade tissue, and the highly lacunar spongy parenchyma with stellately arranged cells.

The rhizome is rather stunted and densely covered by ramenta on the upper side, and by roots all over (Fig. 1). The petioles arise slightly oblique, are fairly long and carry at the end a single roughly trilobed lamina. The shape of this blade is extremely variable. The petiole is surrounded at its base by multicellular ramenta. The venation of the leaf is of the reticulate type resembling that of *Scolopendrium vulgare*. The reticulation is more dense at the periphery than at the centre. In addition to the single midrib there are three or five prominent lateral veins. The sporangia are distributed all over the under surface of the leaf along the veins.

Anatomy.—The solenostele of the rhizome is interrupted by one or two leaf gaps. Occasionally even three leaf-gaps are present leading to a dictyostelic condition. More than three leaf-gaps have never been observed. The internal and external phloems are quite clear and the pith and cortex are slightly thick-walled. The pericycle is one or two cells thick and phlobaphene does not appear in any conspicuous form.



Figs. I–9. *Hemionitis arifolia* (Bur.) Bedd. 1. Rhizome with sterile leaf. 2. Transverse section of rhizome showing two leaf gaps, thick-walled cortex and pith, and leaf traces. 3–7. Transverse sections of the petiole taken at the different levels indicated by arrows in Fig. 1. Fig. 4 is from a different petiole and hence differs from the other sections in size. Figs. 8 and 9 are transverse sections of the blade taken at the levels indicated by arrows in Fig 1. All diagrams are drawn from free-hand sections.

The petiole is long, cylindrical and shows near the base a very shallow dorsal groove. At the very base a transverse section of the petiole shows a C-shaped strand (Fig. 3). Somewhere about the middle, the xylem of the

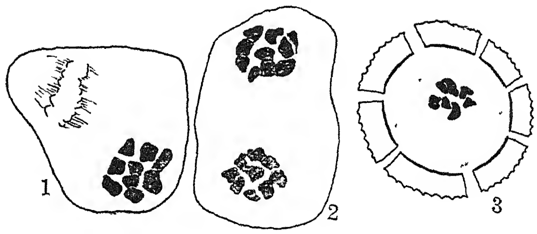
petiolar bundle becomes X-shaped in form—the upper limbs being longer and more spreading (Fig. 4 and Photo 1). The protoxylem groups—about four in number—are arranged along the margin of the upper bay. A little higher up the ends of the two upper limbs of the xylem are abstricted and the lower limbs gradually disappear (Figs. 5 and 6). Still higher up, but a little distance below the junction of the petiole and lamina, the two abstricted strands separate out and form two prominent lateral veins (Fig. 7). At this stage the xylems of the two meristeles are flat or slightly concave while the xylem of the main petiolar strand is V-shaped. Fig. 8 represents a section at a still higher level where more lateral veins have been formed and the midrib xylem has not yet lost its V-form. A section taken near the distal end of the blade shows the midrib and some of the lateral veins cut transversely, with their plate-like xylem. The upper and lower epidermis are covered by a thin layer of cutin. A layer of palisade tissue one or two cells thick, and a highly lacunar spongy parenchyma constitute the mesophyll (Fig. 9, Photo 2). The brief X-shaped condition of the petiolar bundle and the stellate pattern of the highly lacunar spongy mesophyll are amongst the interesting features of the plant.

A comprehensive study of the anatomy and cytology of the plant is under preparation and will be published elsewhere.

Department of Botany,
University of Lucknow, A. R. Rao.
April 20, 1946.

CHROMOSOME NUMBERS OF TWO MEMBERS OF THYMELÆACEÆ

The writer wishes to record here the chromosome numbers of two members of the family Thymelæaceæ, namely, *Daphne cannabina* Wall., and *Wikstrœmia canescens* Meissn. The number has been counted from polar views at the metaphase of II meiotic division in the pollen mother cells in case of *Daphne cannabina* and from the first division in the uninucleate pollen grain in case of *Wikstrœmia canescens*. The haploid number of chromosomes in both the species is 9 (Figs. 1–3). The number of chromosomes of *Daphne cannabina* is determined for the first time while that of *Wikstrœmia canescens* was previously reported by Strasburger (1909).[3] The present count in the latter species by the writer confirms Strasburger's report.



FIGS. 1 and 2. *Daphne cannabina.* II metaphase in P.M.C. FIG. 3. *Wikstrœmia canescens.* I division in the uni-nucleate pollen grain. Figs. 1, 2 and 3, × 1700.

A list of chromosome numbers in the family Thymelæaceæ is given in the following table. The list includes eleven species belonging to three genera of Thymelæaceæ. From the same, it will be observed that $n=9$ is common to all the three genera. Two members included in the list, however, form an exception. They are *Daphne odora* and *Wikstrœmia indica*. In the former n is mostly 14 and occasionally 12 and 13, while in the latter it is 26. From the present available data on the chromosome number of the family Thymelæaceæ, it would appear that the basic number of the family is nine. Determination of chromosome number of the remaining species would be necessary to find out if the family is represented by more than one basic number.

The writer is indebted to Professor A. C. Joshi, D.SC., Government College, Lahore, for the material used in this investigation.

Species	Chromosome number n	Author
1. *Daphne mezereum* L.	9	Strasburger (1909)[3]
2. *Daphne alpina* L.	9	,,
3. *Daphne pseudo-mezereum* A. Gr.	9	Osawa (1913)[2]
4. *Daphne kiusiana* Miq.	9	,,
5. *Daphne odora* Thunb.	mostly 14, occasionally 12 and 13	,,
6. *Daphne Laureola* Linn.	9	Fuchs (1938)[1]
7. *Daphne Cneorum* L.	9	,,
8. *Daphne cannabina* Wall.	9	Venkateswarlu (present report)
9. *Wikstrœmia indica* C. A. Mey.	26	Winkler (1906)[4]
10. ,, ,, ,,	26	Strasburger (1909)[3]
11. *Wikstrœmia canescens* Meissn.	9	,,
12. ,, ,, ,,	9	Venkateswarlu (present report)
13. *Gnidia carinata* Thunb.	9	Strasburger (1909)[3]

Andhra University,
Guntur, J. Venkateswarlu.
March 4, 1946.

1. Fuchs, A., *Osterr. Bot. Zeitschr.*, 1938, **87.** 2. Osawa, I., *Jour. Coll. Agri. Tokyo*, 1913, **4.** Strasburger, F., *Histol. Beitr.*, 1909, **7.** 4. Winkler, H., *Ann. Jard. bot. Buitenzorg.*, 1906, ser. 2, **5.**

REVIEWS

Electron Optics and the Electron Microscope. By V. K. Zworykin, G. A. Morton, E. G. Ramberg, J. Hiller and A. W. Vance. (John Wiley & Sons), August 1945. Pp. 766. Figs. 546. Price $10.00.

In this book the authors have dealt with the subject of electron optics and electron microscope in a very comprehensive manner. It is divided into two parts.

Part I contains a non-mathematical treatment of the subject with full technical details whereas in Part II the authors have dealt with mathematical theories of electron optics and its applications.

Part I opens with the physics of electron optics—the application of light optical theories and principles in electron optics. The different instruments—the electron microscopes of electric and magnetic types which utilise these principles are then described. After showing the distinct advantages of electron microscopes over light-optical microscopes the authors proceed to describe the different types of electron microscopes that are actually being used in different kinds of scientific researches. The book gives elaborate description of every part of the instrument in a very systematic way. Part I concludes with a discussion of the application of electron microscopes in various fields of scientific research—Chemical, Biochemical, Biological and others.

In Part II the authors have tried to give a full theoretical and mathematical background for the further study of the subject. Chapter I deals with the principles of light optics and shows how these are similar to electron optical principles and how they can be successfully applied to electron optics. Coming to the chapter on electron lenses the authors have given both theoretical and practical methods of determining the potential distributions of any two electrodes forming an electron lens. They have included in their discussion different types of lenses used for different purposes, their properties and performances. After describing electric lenses they have discussed the magnetic lenses and in this connection have dealt with magnetic fields, their properties and applications as lenses.

The later chapters are devoted to a discussion of the various defects of each type of lens, the causes of these defects and the methods of rectification. The last chapter deals with the mechanism of image formation in electron microscopes with different apertures. In this connection the authors have given an account of contour effects, the limits to resolution and the limit of recognition of small objects.

The authors have succeeded in helping the electron microscopist in understanding his instruments much better and using it to his best advantage. The reviewers have no hesitation in recommending this excellent book to the scientific worker dealing with electronic equipment in general and electron microscope in particular.

S. M. D. G.
J. C. G.

The Purification of Water Supplies. By George Bransby Williams. (Chapman & Hall, Ltd.), 1946. Pp. 95. Price 7/6 net.

In the far-off days when the twin steamers, the Peninsular and Oriental, used to handle the "ferry" traffic between Aden and Bombay, the captain of the Peninsular said to the present reviewer, then on his way to India for the first time, "You scientific men will be the death of the unfortunate Indian villager, he has grown to be immune to the danger of drinking dirty water and now with all your improvements you will destroy this immunity." Curiously the same possibility is referred to in the Epilogue to the volume under review. Recently also Mr. Gandhi remarks on this possible immunity. This does not prevent Mr. Bransby Williams from advocating the most up-to-date methods for water purification or Mr. Gandhi from urging the necessity for mental and bodily cleanliness. Insensitiveness to impurity of any kind is indeed a mark of a low standard of living, and there need be no hesitation, therefore, in advocating the adoption of the *best* without being constantly reminded that it may be "the enemy of the good". The reply to those who would argue that "India is a poor country and cannot afford these modern methods" is that it is better to provide even a fraction of the best which remains as a standard, than to supply a complete but inefficient whole. A small plant which will produce *some* pure water is better than a large installation which delivers a supply still not above suspicion.

Subject to the foregoing understanding Mr. Bransby Williams' book can be unreservedly welcomed. The general introductory matter is clear and readable and the methods and mechanisms described are carefully chosen and critically discussed. As an engineer he is to be congratulated on the soundness of Chapter I on the Chemistry of Water Treatment. The rather difficult explanations of hydrogen-ion concentration and the determination of pH are handled in a manner which will be welcomed both by beginners and by older workers in this field.

Chapter II on Coagulants is simply concentrated information, two pages consisting almost entirely of typical chemical equations. Chapter III deals with less quantitatively definable matters such as colloids, colour and the various micro-organisms occurring in waters. It might perhaps have been useful if some simple but characteristic diagrams of typical organisms could have been included.

The author modestly prefers to quote experienced authorities when he feels that the subject is better dealt with by direct quotation rather than by second-hand paraphrase. Thus the excellent Chapter IV on Self-Purification of Water quotes largely from the *American Manual of Waterworks Practice* and from Dr. Adeney's book on the *Dilution Method of Sewage Disposal*, following in this last respect the example of the present reviewer in his own publications.

In the more descriptive chapters on Chemical Precipitation, Softening of Water and Filtration, only the most recently adopted and proven plants and methods are described including flocculation mechanism, clarifying mechanism and the "accelator" process for the addition of softening chemicals. Base exchange methods are illustrated and mention is made of the use of organic bases capable of removing, on a laboratory scale at any rate, the solids from sea-water.

In the chapter on Filtration, including as it does, various mechanical filters, it would have been interesting to have the author's opinion of the use of "activated *silt*" for purification of water on the same principle as activated sludge is used to purify sewage. The idea was derived from the observation of the self-purification of the silt-laden waters of the Yangtze. The principle has been adopted at one of the Birmingham sewage works, loam being used as a vehicle for the purifying bacteria, and it is reported to have been used at more than one centre for the purification of water in place of mechanical filters. The type of mechanical filter using constantly moving sand is in fact a stage in the development of the idea.

The last long chapter on Sterilisation may be of special importance for India where cheap electrical power is becoming increasingly general. For many years the use of *ozone* which has long ago proved its efficiency at several centres in Holland and France has been held up on account of cost. Provided it can be supplied at a cost reasonably competitive with chlorine, its simplicity as compared with the many pitfalls attending the use of chlorine, well described in the present book, will give it easy preference.

In conclusion, it may be hoped that wide agreement may be shown by those in authority with the author's most wise and experienced recommendation that careful scientific investigation should precede every new scheme of water supply. In this investigation and subsequent control, as he rightly says, in the concluding sentence of his valuable and interesting book, "chemists, bacteriologists, engineers and waterworks managers, all need to take their full share".

G. J. F.

Electric Power System Control. By H. P. Young. Second Edition Revised. (Published by Chapman & Hall), 1946. Pp. xii + 369, with 249 Figs. 25 *sh.* net.

The book is one of a series of Monographs on Electrical Engineering brought out with the aim of providing practical engineers and advanced students with an up-to-date survey of a particular branch of the subject.

The subject-matter of the volume under review is one in which the advances made during the past few years, especially with the advent of the Grid System, have been phenomenal. In view of the fact that the literature dealing with these advances is not only voluminous but is also widely scattered in numerous journals, the presentation of the subject in a book form is most welcome.

The book opens with a chapter on the Parallel Operation of Generators and the characteristics of exciters, which are of fundamental importance to a clear understanding of some of the problems relating to system control.

This is followed by two chapters on the subject of Automatic Regulation of Synchronous Machines, both for voltage and power factor control—a subject which has an important bearing on system stability.

The fourth chapter deals with the Automatic Synchronizing of Generators, which is now more or less universally adopted in all large power stations with a view to avoid heavy current surges.

The next four chapters relate to Switchgear and associated problems such as control of short-circuit power by the use of reactors, different types of circuit breakers, power station switchgear arrangements, and short-circuit calculation. The special attention paid to the subject of Airblast Circuit Breakers which is being developed considerably during the last few years, is very appropriate and welcome. It seems probable that for switching at 33 Kv and above, especially in the larger sizes, the airblast circuit breaker might ultimately replace the oil circuit breaker, since it possesses the important advantage of containing no fuel which might assist in the spreading of a fire breaking out in the switch room. Also since air is employed as the extinguishing medium, fresh air is available for every operation, and owing to the shorter breaks and arcing times, the arc-energy is only a fraction of that in an oil circuit breaker, resulting in less burning of the contracts. The elimination of the necessity for changing the oil periodically and for draining the breaker before contact inspection can be made, will also greatly facilitate the problem of contact maintenance.

Chapters nine and ten are devoted to the important subject of Interconnection of Power Stations and Apparatus for Interconnector Control such as boosters, tap-changing gear, and induction regulators.

The book concludes with a chapter on the Principles of Automatic Supervisory Control, which provides a reliable means of affecting all system of operations from a distance and thereby permits the control to be centralized.

In a work of this kind, selection of material is no easy task if the size of the book is to be kept within reasonable limits. Obviously the author has mainly in view the needs of the practising engineers engaged in electric power system operation, and students specializing in power engineering.

There are over 200 line diagrams and photographs illustrating modern practice, many of

them being taken from the technical publications of leading manufacturers. The bibliography at the end of the book will be found very useful. The printing and get-up of the book are excellent and leave little to be desired. The book should find a place in the library of every electrical engineer.

H. N. RAMACHANDRA RAO.

Electrotechnics, Nos. 17 and 18. Journal of the Electrical Engineering Society, Indian Institute of Science, Bangalode. Edited by D. J. Badkas, M.SC., A.I.I.SC., A.M.I.E. (Ind.)

The issue under review is a combined number for 1944 and 1945, and contains many articles of interest to the electrical engineers. The distinguished contributors include the late Professor J. K. Catterson-Smith, Professor S. P. Chakravarti and Brigadier H. H. Berridge (I.E.M.E.).

It is difficult to pick out for special mention any article since they are all of high standard but mention may be made of the following articles as of special interest to Indian readers. 'On the possibility of an Ultra-short wave first grade broadcasting service in India,', 'Electric power development in C.P. and Berar', 'A high voltage testing laboratory for India', and 'The combustion gas cycle and its application'.

The Journal maintains its usual high standard both in its contents and get-up, and deserves to be read by all interested in the field of electrical engineering.

B. N. N.

SCIENCE NOTES AND NEWS

Hair-Ball in the Stomach of a Calf.—Mr. M. C. Nambudripad writes from Vilayur as follows:—

I READ with appreciation the letters published in the February and March issues of *Current Science*, in the above matter. I hope, the following observations will be of general interest.

In certain parts of Malabar, when cattle die, they are handed over to the *Pariahs*. As they cut open the abdomen of the dead animals, they sometimes come across such hair-balls. I have, as a matter of fact, got such balls with me. The balls, however, are smaller in size than that described in the note in the February issue of *Current Science*.

The hair-ball has its use also, as a cure for ringworm in the head, with complete loss of hair from the infected parts. It is rubbed for some time daily in the affected places for some days, when tiny brownish hair will begin to appear. The rubbing may then be stopped. The new hair will gradually turn black and grow like ordinary hair.

Is it the mere rubbing that destroys the infection, or is it a special property of the hair-ball?—I cannot say. There is room for research.

Sixth International Congress for Applied Mechanics—In line with the decision reached at Cambridge in 1938, it is proposed that the Sixth International Congress for Applied Mechanics be held in Paris, from September 22 to September 29, 1946. The invitations to the Congress are extended on behalf of: l'Academie des Sciences de l'Institut de France, la Direction des Relations culturelles, le Centre national de la Recherche scientifique, l'Institut de Mecanique de la Faculte des Sciences de Paris, la Societe francaise des Mecaniciens, l'Association technique Maritime et Aeronautique. The Congress will meet at the Sorbonne. The Congress will be divided into the following Sections: (1) Structures, Elasticity, Plasticity; (2) Hydro- and Aerodynamics, Hydraulics; (3) Solid Dynamics, Vibration and Sound, Friction and Lubrication; (4) Thermodynamics, Heat Transfer, Combustion, Fundamentals of Nuclear Energy. Besides the papers presented in these Sections, a number of General Lectures will be given on subjects of current interest. The titles of these Lectures will be made known in a later notice. Those who desire to become members of the Congress are requested to inform the Secretary-General as soon as possible of their intention to attend the Congress. They shall also indicate at the same time whether they wish to present a paper, and in what Section. This is required in order to facilitate the preparation of the program and the issuing of further notices. Communications are to be addressed to the Secretary-General of the Sixth International Congress for Applied Mechanics, Institut Henri-Poincare, 11, rue Pierre-Curie, PARIS (V).

Dr. F. Verdoorn, Managing Editor of *Chronica Botanica*, and Botanical Adviser to the Board for the Netherlands Indies, Surinam and Curacao, writes that since his previous reports (*Science*, Nov. 16 *et ante*) the death has been announced of the following biologists and agronomists in the Netherlands Indies:—Dr. J. D. F. Hardenberg, Director, Laboratory for Marine Biology, Batavia; Dr. Ir. Ch. Coster, Director, Experiment Station, West Java, Buitenzorg, formerly Chief Forester (executed July 1943, by the Japanese).

Scientists in the Far East.—According to word received from Singapore, Dr. M. A. Donk, Mycologist of the Buitenzorg Botanical Gardens, Dr. G. Giesberger, Microbiologist, and Dr. L. van der Piji, known for his work on floral biology, are in Singapore, in relatively good health. Mr. R. E. Holttum, Director of the Botanical Gardens of Singapore, is now in England; Dr. E. J. H. Corner is in charge of the Gardens during his absence. Dr. M. R.

Henderson, the Curator of the Gardens, who spent the war years in Newlands, South Africa, is on his way back to Singapore.

Of internationally known biologists in the Netherlands Indies, it may be of interest to state that the following were alive last October:—Miss Dr. B. Polak, Research Associate, Institute of Soils, Gen. Agric. Expt. Station, Buitenzorg; Dr. D. F. van Slooten, Chief, Herbarium, Government Botanic Gardens, Buitenzorg; Dr. H. J. Toxopeus, Head, Bot. Lab., Gen. Agric. Expt. Station, Buitenzorg; Dr. L. J. Toxopeus, Entomologist, Zoological Museum, Buitenzorg; M. A. Lieftinck, Chief, Zoological Museum, Buitenzorg; Prof. Dr. K. B. Boedijn, Director, College of Agriculture, Buitenzorg; Dr. M. Hille Ris Lambers, Geneticist, Expt. Station, Central and East Java, Malang.

A more or less complete list of scientists who were in the Netherlands Indies at the time of the Japanese invasion, with notes about their position, at that time, has been prepared by F. and J. G. Verdoorn and will be published shortly in *Science and Scientists in the Netherlands Indies*, edited by P. Honig and F. Verdoorn. Copies of this list, interleaved with blank paper, may be obtained without charge, from the Librarian, Central Depository Library for the Netherlands Indies, 10, Rockefeller Plaza, 14th Floor, New York 20, N.Y., or the Editor of *Chronica Botanica*, P.O. Box 151, Waltham 54, Mass.

GEOMAGNETIC STORMS

A considerable number of geomagnetic disturbances were recorded at the Alibag Magnetic Observatory during the quarter ending March 1946. Some details of those geomagnetic storms which have been classified as great or very great according to the standards of the Alibag Observatory have been given in the following table in which t, t represents time, (I.S.T.) of commencement of the storm and its intense phase respectively and T, the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field as recorded at the Alibag Magnetic Observatory during the storms have also been given, D in minutes of arc and H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k-index (k_m say) recorded during the storm has also been given in Table I below.

The storm of February 7-8, though cannoto be classified as very great from a consideration of ranges only, it was remarkable for a number of very short period fluctuations lasting for 2 to 3 hours each time. The vibrations in all the three elements were sometimes so rapid that it could not even excite the photographic paper properly and as a consequence the magnet traces were faint at certain times. This storm is no doubt connected with the passage of the great sunspot which crossed the central meridian on the 5th February 1946. It is reported that the usual aurora borealis have also been observed in high latitudes during the storm. A number of solar flares of the type which are usually associated with radio fade-outs were also recorded during the storm and also before its commencement.

The storm of March 28-29 is the most intense (from the standpoint of range measurement) of all storms recorded at Bombay during the last one hundred years. Previous to this the maximum range in H was 1023 attained during the storm of the 4th February 1872, when even aurora was seen at Bombay. Radio fade-outs and also disturbances in telegraphic transmissions are usually associated with this type of magnetic storms. This storm is also possibly associated with an active spot-group which crossed the sun's central meridian on the 27th March 1946. Distinct solar flare effects were, however, not noticed in the present case.

From the nature of the records it can be said that in the case of all the storms referred above their commencements have also been recorded practically simultaneously on all the different magnetic observatories of the world.

Date	t_0	t	T	R: D	R: H	R: V	k_m	Nature of commencement
1946	H. M.	H. M.	hrs.	min.	γ	γ		
January 3–4	13 37	16 00	4	8·7	278	43	8	Sudden
February 7–8	15 48	16 00	6	10·7	241	57	7	Sudden
March 9–11	17 30	20 00	6	6·2	158	61	6	Gradual
March 22–26	11 08	..	9	7·1	420	67	7	Sudden
March 28–29	12 05	13 30	6	22·8	1041	141	9	Sudden

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INDUSTRIAL DEVELOPMENT AND GOVERNMENT POLICIES*

THE industrial life of this country has long been on a low level and wholly unsatisfactory. What our Organization has been pleading for, for the past six years, have been privileges and concessions which all progressive Governments are accustomed to grant or provide for the orderly growth of national industries. The demands we have been putting forward are mostly such as business men freely received in countries like the Dominions of Canada and Australia. Those members of the British Commonwealth, it might be remembered, have Governments which are in complete sympathy with their respective populations. In this country too the activities of industrialists and businessmen would in all probability have borne similar fruit and they would have led to a high level of productivity and prosperity had the Government of this country not been directly opposed to the views and wishes of our business population in this matter.

Perils from Further Neglect of Industries

To what low level the industrial performance of our population has fallen will be understood from a comparison of the estimated average annual *per capita* production from industries which is about Rs. 15 in India and Rs. 800 to Rs. 1,000 in the two Dominions I have just named. All the facts and figures available—the retardation of industries before the war, the persistent obstruction to the automobile industry and the deliberate omission of heavy civilian industries during the war cannot lead to any other conclusion than that the present Government have been hostile to the promotion of industrial life of our country.

The result of past policies of retardation of industries has been expensive unemployment, short employment, malnutrition, chronic economic distress and at times starvation among vast masses of rural and labour population. The past policies and the present attitude of Government create a fear in the people's minds that the future of industries in this country under the present bureaucratic administration is wholly unsafe. The future is full of uncertainty and safety lies in rousing the nation to a sense of its perils by a campaign of economic preparedness undertaken by well-informed or expert public-spirited citizens in all parts of the country.

Government Mechanism to Help Industries

The informed public in the country has always desired that industries should be a Federal subject but Government have for their own reasons transferred the subject to Provinces under the Parliamentary Act of 1935.

* Extracts from Sir M. Visvesvaraya's Address to the First Quarterly Meeting of the Central Committee of the All-India Manufacturers' Organization, 9th June 1946.

Industries is the most important source of production and income in the Dominions, in England and in the United States of America. To relegate such a subject to the inexperienced direction of the Provincial administrations is itself proof of Government's disinclination to foster industries.

The immediate needs are—a well-equipped Industries Department at the Centre and the appointment of a full-time Minister in charge. To remove the present lack of touch between the Government and the public in this sphere an Industrial or Economic Council should be brought into existence. The Council will act as a liaison agency to bring together the Government which has the power and the industrialists and business men who have the need of the protection of that power in the interests of industrial development.

I have often recommended a grant of, say, Rs. 6 crores to be distributed among the provinces for preparing the country for industrial development, for supplying industrialists with the necessary information concerning machinery, experts, and other facilities required and for conducting the research work needed. In foreign countries like Australia, Government help industries by a permanent Tariff Board and adequate tariffs and subsidies.

Research work has been going on for four or five years but it was utilized mainly for war industries. It did not extend to any appreciable extent to civilian industries. Heavy industries, even those required for war, were kept out of the country. The establishment of the automobile industry received special discouragement and an aircraft factory started by Indian initiative was not allowed to manufacture planes. When the time for actual manufacture came, it was reduced to a repair shop.

Research work in the various Universities and Educational Institutions is going on without any appreciable direct contact with heavy industries. There is no one appointed to take stock of work done at the end of each year and to see that the money spent is being wisely used to promote industries.

General Equipment to Promote Industries

Adequate facilities are provided in every progressive country for the promotion or growth of industries. The usual equipment falls under some half a dozen heads, namely, tariff protection, subsidies, banking and finance, statistics, technical and commercial education, and travel facilities. In such countries these wants are attended to either by Government establishments or by private companies or firms, and Government give every facility in their power to supply or promote the wants as soon as they come to their notice.

No attention is paid to these wants on any system in India. A Tariff Board has been newly appointed, but it is not permanent nor has it power or specific duties to foster industrial growth as the corresponding Board in Australia for instance, is vested with. The tariffs *are not adequate to keep out unwanted foreign imports*. Until recently banking facilities were not adequate but a great development has taken place during the war period mainly through the efforts of prominent business men and groups. The want of adequate statistics has long been one of the main obstacles in the way of reliable planning and development. In the absence of statistics the country does not know where it stands. Technical and commercial education available is very limited. Travel facilities within the country are not organised. Hotels and transport facilities for trade and industry are not developed to suit the classes of people who would use them. It must be mentioned, however, that since the close of the war, Government have been giving opportunities to small deputations of leading industrialists and scientists to visit England and America. It is also pleasing to have to state here that within the past few days a *small handbook of statistical information has been issued from New Delhi*. There has been no time to assess the value of the statistics now placed at the disposal of the public but the publication itself is a welcome sign of change in the Government outlook.

Special Equipment for Immediate Needs

Industrial advance everywhere largely depended upon the sympathy of the administration and that sympathy has been lacking in the present case. It can only be supplied by a Democratic or National Government. Some time ago, our Organization put forward a few urgently needed constructive proposals for the consideration of the Government and the public. Among these were a *Technological Institute, Machinery Manufacture, Establishment of Firms of Consulting Engineers* and *Manufacture of Defence Machinery*. Several larger proposals of this description have been approved or were independently put forward by the Government of India in 1944-45.

Since they came to know that there was dissatisfaction due to the utter neglect of civilian industries in the first three years of the war, Government have established a special Planning and Development Department and appointed an Industrialist of known ability to be in charge. The Minister studied the conditions, organised the necessary staff, travelled through the country and after a visit to England and the United States of America put forward a large number of proposals and made several important promises on behalf of the Government of India. The then Secretary of State for India, Mr. L. Amery, spoke enthusiastically and practically endorsed those promises. But for some reason not known for the public the new Planning and Development Member had to quit office and although the machinery he started is allowed to continue and money is being spent, no work of a constructive character has begun. No single heavy industry of any importance which was favoured by the Member seems to have come into existence.

One of the proposals put forward by the new Planning and Development Department was the nationalization of industries. Care will have to be taken that the present capitalist system is not disturbed or summarily abandoned because in the present primitive stage of development, capitalism is likely to serve the country's purpose better than nationalization. The question of nationalization may be taken up if considered necessary after the present working

conditions are brought into conformity with the highest ideals and performances in capitalist countries.

Heavy Industries

To give training in heavy industries is a vital necessity at the present time. It needs no saying that heavy industries are of the highest value both for production of commodities and for building up armament and other Defence machinery. But these industries were retarded before the war, kept out of the country during the war, and obstacles of various kinds—many avoidable, some perhaps inevitable, are now impending progress in post-war period.

This Organization issued a small pamphlet in 1945 in which were given lists of heavy industries which business men in various parts of the country wished to see established. The manner in which it was proposed to distribute these heavy industries among the various Provinces and States was also detailed. A balanced distribution was suggested because heavy industries in the country were few and they had been very unequally distributed. Government have done nothing themselves even on this proposal. No notice has been taken of the suggestion that private entrepreneurs and industrialists who are eager to start industries should be given encouragement. The eagerness is still there but there is at the same time some hesitation and doubt that industries after they are actually started may come to grief.

There is abundant scope for the rapid establishment of key and heavy industries like steel, power, internal combustion engines, mill machinery, railway machinery and plant, automobiles, aeroplanes, dye-stuffs, drugs, and the like. Private capitalists and indigenous companies can promote many or all these industries if trust in Government policies is restored. This object would be gained if direct encouragement is given in the shape of contribution to share capital of companies, of removal of impediments when brought to notice without prolonged delays, of sanction of priority for foreign purchases, and foreign exchange. and transport of essential machinery from foreign countries.

Village Group Industrialization Scheme

A proposal for the development of lighter industries in rural areas to which this Organization attaches considerable importance is what is known as the Village Group Industrialization Scheme. This scheme deals with groups of 5 to 10 or more villages in a district, each group having an aggregate population of about 15,000. A Committee of 7 to 12 members chosen from the most competent people of the area is appointed to work for the introduction or establishment of small-scale industries.

The object of this scheme is to form village group units and train the population in each group to organize, establish or promote small-scale industries on modern business principles.

Incidentally another object is to increase the working power of the individual citizens, families or groups of citizens by giving them opportunities of working in team spirit and on the self-help principle.

A Central Village in the group will be selected to form the seat or headquarters of the committee. The committee will employ honorary workers or engage the staff necessary to instruct the rural population to establish and carry on minor or cottage industries. The scheme contemplates training the people in organization, power of initiative and self-help generally.

Now that the war is over, it should be possible to hold rural conferences under the supervision of local leaders, to draw up supplementary rules and give village group committees opportunity to develop sound village administrative practices.

There are 700,000 villages with a population of about 350 million in this country. If this scheme is efficiently and effectively worked, the prospects of village life will indeed become appreciably brighter at no distant date. After an effective start is made with industries, other developments in village reconstruction may be taken up, eventually leading to nation-building. For a clearer explanation of all that is proposed, reference is invited to the several pamphlets on the subject issued by our Organization.

Doubling Production in Five to Seven Years

On account of world changes due to progress of science and the two world wars, changes will be necessary also in the outlook and habits of the working population—more particularly in village life.

Somehow mass education was neglected in the past. Education was given only to the richer and enlightened classes. Everybody was content with that.

An enormous number of vocational and occupational schools, say, at the rate of about 50 in every district are a prime necessity. The Universities and Educational Institutions should recognise the importance of developing the *man-power resources of the country by a liberal expansion of elementary and technical education*. Also practices of increasing production and income by the use of machinery should become common. The people should be taught to work harder, to work under discipline, to utilise machinery to practise thrift and gradually develop team spirit and the habit of collective effort.

The country is quite ready for all this kind of work and training, but organization and power of initiative have been lacking. This is because even in the matter of production, Government do not see eye to eye with the people. They have their own bureaucratic methods which kill initiative and the self-help spirit. Every Village Group Committee should begin by watching progress in productivity and income (first in industries and after two or three years both in industries and agriculture) by statistical measurement. If this is done and special regard is paid to both quantity and quality of products in the two spheres, there is every prospect of production and income in the village unit area being doubled in five to seven years' time.

Practice of Storing Two Years' Food Supply

From the experience gained in Calcutta in 1943 and again in the current year in various

parts of India, it is clear that world conditions have changed and that it would be safer for our population in every area *to store sufficient food for emergencies in advance.* In former times and even now in many parts of the country food grains are stored in underground pits or large pottery or earthenware vessels. There is no reason why sufficient food supply should not be stored to *last for a couple of years.* The cost of food in normal years will be small and as a measure of self-protection the village population will learn to store food grains and to change them from year to year to keep the hoards fresh.

One of the advantages of village group unit will be that the responsibility for food storage for the future could be very appropriately taken over by the village units themselves.

The training in self-help and self-sufficiency in this manner will be of special value in preparing the enormous rural population to look after its own subsistence interests to a very material extent and lighten the burden of administration of feeding the populations in their charge in famine times. The spirit of self-help and self-sufficiency which will be acquired by such habits of prudence will be a gain of national value.

Insufficient Attention Paid to Industrial Development

From what I have stated so far two sets of inferences emerge. One is that equipment usually provided by progressive governments for promoting industries is lacking, and no signs exist that Government here were actuated by any desire to promote industries.

The second is that our Association—the A.-I.M.O.—is endeavouring, in however feeble a way it may be, to serve the cause of industries—by inducing business men to organize new factories and establishments, by persuading manufacturers and business men to work in team spirit, by advocating the liberal use of machinery and machine tools wherever it helped to economise human labour or increase production, and by rousing public interest in industries and doing whatever was possible to make the ordinary citizen industry-minded.

We are also endeavouring to bring to the knowledge of the common people the changed conditions of the business world, how safety lies in their following the post-war activities of progressive nations to the extent permitted by our resources, and how they should improve and strengthen their working power by increasing their knowledge and skill, by adopting modern business practices and resort to collective action whenever circumstances demanded.

No Comprehensive Outlook

The country is suffering from manifold deficiencies and evils among which illiteracy on a colossal scale may be said to be the most grievous. Enormous man-power which is badly needed for the country's uplift is left idle and is being wasted. The growth of population without a corresponding increase of income is another great evil. Unpreparedness for defence at a time when transfer of political power is imminent is a third. Alongside all these, comes the Government's persistent opposition to the growth of industries, particularly of the large scale or heavy type. Little attention is paid and practically no money spent on what truly constitutes the life-line of the country's business system and what ought to be treated as Government's vital and foremost responsibility.

Planning based on a study of deficiencies and wants is the best means of bringing the country's affairs into an orderly manageable shape. At present in the name of post-war reconstruction a number of schemes are being sanctioned but they were selected after consulting responsible public men interested in the developments. A few proposals like the expansion of electric power, irrigation, etc., have been approved or sanctioned, but this is being done without examining or taking into account schemes which are more urgent or important and before any unified development policy is declared in consultation with leaders who know the country's needs. The working power and employment prospects for the poorer rural and labour population are alarmingly low. The country is meeting the future unprepared.

JOURNAL OF COLLOID SCIENCE

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PREWAR Germany had secured a well-deserved leadership in the field of scientific Journalism; *Kolloid Zeitschrift* was the internationally recognised medium through which much of the specialised work in the field of colloids found adequate expression. The fate of this publication, however, is yet unknown. In the meanwhile, there has been an ever-increasing expansion of research activity in the field of colloids, both pure and applied. Colloid science has permeated and influenced newer fields of technology thanks to war-time developments in plastics, elastomeres, synthetic fibres and high polymers. A medium for the publication of developments in these expanding fields became an imperative necessity; this has found its fulfilment in the *Journal of Colloid Science,* which represents the first journal on colloid science in the English language; it is "devoted to scientific, technological and biological aspects of colloid science." The Journal has the support of an international panel of distinguished and familiar personalities in the field of colloid science and is published by Academic Press Inc., the well-known publishers of scientific literature. We share with the publishers the "hope that this publication specialising in problems of colloids and surface phenomena will make it easier for the members of the research laboratories of universities and industries to follow up developments in this field of science and to find inspiration for its application". We wish to extend to the Journal a hearty welcome and wish it a career of expanding service.

SUNSPOTS AND MONSOON RAINFALL IN INDIA

By V. SATAKOPAN, M.A.
(*Assistant Meteorologist, Meteorological Office, Poona*)

WITH the near approach of the sunspot maximum in 1948, 1949, one feels inclined to examine the claims made by earlier workers regarding the association between sunspots and rainfall with a view to find out whether a general indication of the character of the coming rainfall seasons can be had from a study of the trends in sunspot variation. The inquiry will be all the more opportune just now in respect of Indian rainfall in view of the food situation and the important bearing the coming monsoon season will have on the same. The aim of the present article is, therefore, to review the claims put forward by earlier workers with up-to-date data and to find out whether there is any justification for the claims.

Sir Gilbert Walker,[1] after correlating the annual rainfall over 154 stations over the globe with annual sunspot numbers prepared a map of the correlation coefficients and formulated the following broad conclusions:—

(1) "The general impression left by an examination of the chart may be one of disappointment at the comparative insignificance and inconsistency of the results; and it would appear from the previous section that the irregularities of local distribution are, in some cases at any rate, responsible for this. But it would appear that the coefficient of rainfall with sunspots is not in general larger than would be produced by mere chance; for among 100 stations whose rainfall may be regarded as independent the probable value of the largest coefficient is four times the probable value for a single station. It is only where the coefficients over a region have some appreciable tendency towards uniformity that a real relationship may be concluded. The relationships seem real in the case of the Nile and India; but perhaps the clearest case is South America, where below latitude 30° rainfall is deficient when sunspots are numerous."

(2) "In the case of India, for example, the correlation coefficient of sunspots with the total annual rainfall over the plains as given by all the stations in existence since 1865 to 1912 is $+0 \cdot 26$."

He, however, found that the correlation coefficients in respect of nine individual stations which he selected for India were very small varying between $-0 \cdot 03$ to $+0 \cdot 19$. "The natural explanation is," he says, "that the variations in solar activity affect the monsoon as a whole, but not the irregularities in the geographical distribution of the rainfall of India as a whole."

Sir Gilbert's conclusions indicate a positive relationship between sunspots and rainfall in India as a whole. According to this, years of sunspot maxima should be associated with years of abundant rainfall and sunspot minima with years of scanty rainfall.

Stetson[2] while summarising the effects of sunspots on weather as investigated by Mr. Clayton, says:—

"South America, Africa, *India* and Australia all show again 10 to 20 per cent. more rainfall during sunspot maxima than during sunspot minima."

We shall, in what follows, review the relationship between sunspots and the monsoon rainfall in India based on data of the period 1875-1945. For annual sunspots the mean annual sunspot numbers published by Wolf and Wolfer have been used supplemented by final sunspot numbers published in *Terrestrial Magnetism and Electricity* every year. For 1945, however, a provisional mean sunspot number of 38 has been assumed as no final figures are yet available. For rainfall, the departures of monsoon rainfall (June-September) for the two large divisions of "*North-West India*" and "*Peninsula*" have been considered separately. The two large divisions are the same as those used in seasonal forecasting in the India Meteorological Department. "*North-West India*" includes United Provinces West, the Punjab, Kashmir, North-West Frontier Province and Rajputana. "*Peninsula*" includes Gujarat, the Konkan, the Bombay-Deccan, Central Provinces, Hyderabad and North Madras Coast. The rainfall departure for each year is based on the data of a large number of stations recording rainfall and fairly indicates the average

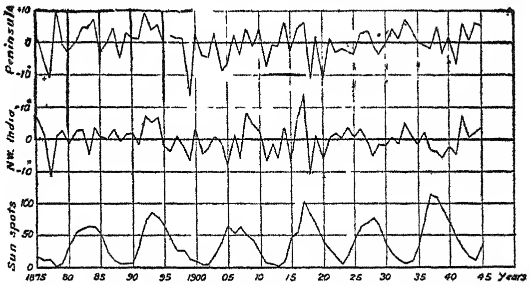

FIG. 1. Sunspots and monsoon rainfall departures

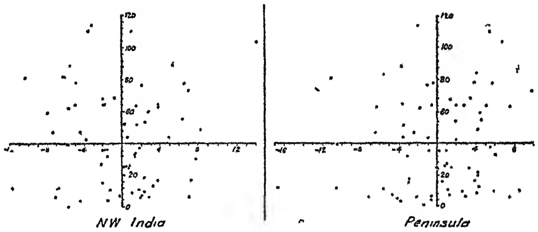

FIG. 2. Dot diagrams of sunspots and monsoon rainfall departures

rainfall condition in each year over the respective region.

Fig. 1 shows for comparison the annual sunspot numbers together with the monsoon rainfall departures in "*North-West India*" and "*Peninsula*" from 1875-1945, a period of 71 years, covering a little over six sunspot cycles. In Fig. 2 are shown the dot diagrams of sunspot numbers and the monsoon rainfall in the two forecast divisions. The points in these two

diagrams are scattered all over and do not indicate any relationship between monsoon rainfall and sunspot numbers in either of the two regions. Any linear relationship between the two elements should have been reflected in the arrangement of the points in the diagram about a line which is not the case here.

A reference to Fig. 1 would, however, indicate that there are a few coincidences such as for the years 1892, 1893, 1894, 1916 and 1917, when both sunspot numbers and rainfall have been high. Similarly the sunspot minima in the beginning of the period is associated with one year of scanty rainfall in 1877 and again in 1899 and 1901 and 1911-1913. But these coincidences stop there and curiously enough during the last two cycles there are instances of a negative relationship between sunspots and rainfall, *e.g.*, 1932, 1933, 1934 and 1935; 1942, 1943, etc.

Table I below gives the correlation coefficients between the sunspot numbers and the monsoon rainfall in "*North-West India*" and the "*Peninsula*" for each of the sunspot cycles, taken from minimum to minimum. The correlation coefficients, each being based on a very small number of degrees of freedom, are not significant but they indicate clearly the changes in the nature of association between sunspots and rainfall from cycle to cycle. There does not appear to be any consistency in the coefficients or their variation. The high coefficients in a few cases are simply the result of a random coincidence of high departure in the two elements and hence should not be interpreted as a consistent relationship.

The table also shows the correlation coefficients for the whole period 1875-1945 as well as for the two sub-periods 1875-1912 and 1913-1945.

TABLE I

Period	No. of years	Correlation coefficients of sunspot numbers with rainfall in	
		North-West India	Peninsula
1878–1888	11	+ 0·125	− 0·136
1889–1900	12	+ 0·468	+ 0·486
1901–1912	12	+ 0·095	+ 0·145
1913–1922	10	− 0·026	+ 0·231
1923–1932	10	+ 0·104	− 0·366
1933–1943	11	− 0·371	− 0·635*
1875–1912	38	+ 0·319	+ 0·226
1913–1945	33	− 0·147	− 0·163
1875–1945	71	+ 0·012	+ 0·094

*Significant at 5% level.

It is clearly seen that what appeared to be a positive relationship during the first three sunspot cycles, has changed into a slightly negative association during the recent cycles. But none of the correlation coefficients in the table is statistically significant except one.

It would, therefore, appear that there is no direct association between the occurrences of sunspot numbers and monsoon rainfall in India that will enable us to know beforehand the character of the monsoon seasons during sunspot maxima or sunspot minima. The following table which gives the average rainfall departures during epochs† of sunspot maxima and minima for the period 1875-1945 confirms this conclusion.

TABLE II (*a*)

Average rainfall departures for epochs of sunspot minima

Period	No. of years	Average rainfall departures	
		North-West India	Peninsula
1875–1880	6	− 0·1	− 0·9
1886–1891	6	+ 0·8	+ 0·8
1897–1903	7	− 1 7	− 2·4
1910–1914	5	− 1·8	+ 0·8
1921–1925	5	+ 1·4	− 2·0
1931–1935	5	+ 1·2	+ 3·4
1942–1945	4	+ 3·6	+ 4·5
	Mean:	+ 0·5*	+ 0·6*

TABLE II (*b*)

Average rainfall departures for epochs of sunspot maxima

Period	No. of years	Average rainfall departures	
		North-West India	Peninsula
1881–1885	5	+ 0·8	+ 2·7
1892–1896	5	+ 2·6	+ 4·2
1904–1909	6	− 0·1	− 1·8
1915–1920	6	− 0·3	− 1·8
1926–1930	5	− 1·1	+ 0·2
1936–1941	6	− 2·8	− 1·4
	Mean :	− 0·1*	+ 0·4*

*Roughly speaking a mean departure of ± 2 only can be considered to indicate any real effect.

The mean departures are very small and do not indicate any marked differences between years of sunspot maxima and sunspot minima.

One another point has also been tested. Whether the increasing or decreasing periods of sunspot numbers are associated with particular types of monsoon? The whole period 1875-1945 has been divided into a number of small periods when the sunspots were increasing and decreasing. The average departures of rainfall for each of these periods and for

†Epoch of sunspot maximum is taken as series of 5 or 6 years in the middle of which sunspot maximum occurs. The whole period of 1875-1945 has been divided into a series of maximum and minimum epochs as shown in Table II (*a*) and (*b*).

all similar periods put together are shown in Tables III (a) and III (b).

TABLE III (a)

Average rainfall departures for periods of increasing sunspot numbers

Period	No. of years	Average rainfall departures	
		North West India	Peninsula
1	2	3	4
1878–1883	6	+ 0·4	+ 2·7
1890–1894	5	+ 3·8	+ 4·4
1901–1906	6	— 2·5	— 2·9
1913–1917	5	+ 2·2	+ 3·2
1923–1928	6	+ 0·5	— 0·5
1934–1938	5	— 1·0	+ 1·3
	Mean:	+ 0·6*	+ 1·4*

It is, therefore, concluded that the apparent positive association observed between sunspot numbers and rainfall in India by Walker and others has not been maintained during recent sunspot cycles. The association between sunspot numbers and Indian rainfall is not consistent from cycle to cycle of sunspot variation and hence it is not possible to judge the character of rainfall seasons from the trend of sunspot variation.

TABLE III (b)

Average rainfall departure for periods of decreasing sunspot numbers

1	2	3	4
1884–1889	6	+ 1·5	+ 1·1
1895–1900	6	— 1·8	— 1·8
1907–1912	6	+ 0·2	— 0·3
1918–1922	5	— 2·5	— 4·2
1929–1933	5	+ 0·6	+ 1·6
1939–1944	6	— 0·2	+ 0·6
	Mean:	— 0·4*	— 0·5*

*Roughly only average departures over ± 2·0 will be significant.

1. Walker, *Mem. Ind. Met. Dept.*, **21**, Pt. 10. 2. Stetson, *Sunspots and Their Effects*, Ch. VII.

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THE BELLARA GOLD MINE

BY B. RAMA RAO

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Situation.—The Bellara Gold Mining block, situated about 95 miles N.W. of Bangalore, lies amidst a thickly wooded deciduous forest covered with Kamara trees (*Hardwickia binata*). It is a mile and a half to the E.N.E. of Bellara, a road-side village, 19 miles to the west of Sira, in the Sira-Huliyar road, in the Tumkur district. Actually the mine is about a mile north of the forty-third milestone in this road and can be reached easily from that spot through a connecting road which has been recently constructed.

The auriferous formation of this region consists of a massive basic igneous rock (locally called grey trap)—bouldery for the most part or somewhat crushed and rudely schisted at places—penetrated by several quartz reefs of various dimensions exposed here and there as disconnected runs. Most of these reefs are found to be gold bearing.

Early History.—The gold-bearing reefs of this area, as in all the other auriferous tracts in Mysore, had been worked to some extent by ancient miners. In 1897 or 1898, the State Geological Department discovered in this region some of those ancient workings. About the same time, one Mr. R. H. Morris, finding a few more of such workings, obtained a license over an area of 9 square miles to prospect for gold. He transferred his interest, soon after, to the Indian Mines Development Syndicate, Ltd., who took over the license from him on option and conducted, in the early years of this century, some extensive underground investigations on two of the most promising reefs in the region.

Commencing their work in 1902 on the eastern reef, exposed prominently on the slope of a small hill, S.W. of Δ 2567, this Syndicate sunk three shafts to various depths and had driven levels at depths of 130, 230 and 330 feet from the surface. After considerable exploration of this reef, which they called the Bellara reef, the work was discontinued, however, at the end of 1905.

At the foot of the the hill, about 1¼ furlongs west of this reef, another reef was located by the Syndicate after a considerable amount of exploration and prospecting. On this reef, which they styled "Tank Reef", ten shafts were sunk altogether over a length of some 2,000 feet, six of the shafts being in a line north and south, and the rest on the sides parallel to them. The shafts were sunk to varying depths, the deepest being a little more than 400 feet. Several levels had been driven at various intervals, to varying distances, from the different shafts and also a few winzes connecting the different levels.

These extensive operations, conducted over some four or 5 years, had disclosed that the western reef (Tank Reef) varied in width from 2 or 3 inches to 2½ feet and in gold value from a mere trace to about 3 ounces per ton with occasional richer shoots. It had been estimated that a few thousand tons of quartz

could be taken out from this reef at an average of 9 dwts. per ton; but still the total tonnage of such quartz was considered insufficient for large-scale operations and the gold value of the reef in depth, at some of the spots tested, was also considered too poor to tempt further extensive explorations beyond. Hence, the Syndicate abandoned the mine, finally, after several years of trial.

A couple of hundred tons of quartz which had been taken out during the course of these operations had been left stacked at the shaft-heads, being considered perhaps as unprofitable for treatment. Some of the local people who were aware of the existence of this gold quartz, took advantage of the situation of the stacks in the midst of the jungle far from any inhabited villages and started extracting gold surreptitiously. We are not quite sure for how long this clandestine practice was carried on, but the culprits were caught, however, red-handed in January 1941. The concentrates recovered from them on assaying in the chemical laboratory of the Geological Department, indicated very rich values, varying from 90 to 500 ounces of gold per ton. Since it was more or less impracticable to prevent altogether such unlawful, underhand, extractions by ordinary vigilance in that forest-covered area, the Geological Department took up in 1943, the extraction of gold by washing the powdered pieces of good-looking quartz, and also the mine debris and soil nearby, in specially constructed washing cradles.

While this work was going on it came to the notice of the Mysore Government that a small section of the workings on the Tank Reef contains a fairly rich zone which was believed to yield about 2,000 tons of auriferous quartz of an average grade of 11 dwts. per ton. On the strength of this information, and after a careful consideration of all aspects, the Government of Mysore decided to have the area thoroughly investigated. In May 1944, they sanctioned the proposal of the Director of Geology to recover the available gold from this known reserve of 2,000 tons of auriferous quartz at an estimated initial cost of Rs. 1·70 lakhs, and also to conduct further large-scale intensive investigations on the reef to ascertain its suitability or otherwise for commercial exploitation.

Present Operations.—The work of the Indian Mines Development Syndicate had indicated that the Tank Reef formed a thin vein of auriferous quartz of an average width of about 2 feet, traceable for a length of over 2,000 feet north and south. The reef with a pronounced westerly dip seems to have been followed on its underlie for over 400 feet in depth, beyond which it had not been traced. For the present operations which commenced in July 1944, almost the central portion of the reef was selected. In accordance with the sanctioned programme for extracting the gold from the proved reserve of 2,000 tons of quartz in this selected portion, the Geological Department started its operations with the cleaning and reconditioning of three of the old shafts which the Indian Mines Development Syndicate had sunk in this section and which, from disuse, had all collapsed and partially filled up with debris. The work done so far since the commencement has resulted in thoroughly renovating these three shafts to depths of 100 to 150 feet, and also the 100-foot level, where the reef had been first met with underground, to about 350 feet north and south and the 150-foot level lower down, to 600 feet. The portions reconditioned expose the auriferous reef right through. The eastern extension of the reef from the 100-foot level is being traced by driving in that direction, and though the reef has been followed till now to about 150 feet it seems to be continuing still further. The present development of the reef so far has exposed and blocked for stoping about 4,000 tons of quartz of an average estimated yield of about 10 dwts. of gold per ton. A few thin splashes and pockets of considerably richer portions are being occasionally met with, which may tend to raise the estimated average yield somewhat higher. From one of such exceptionally rich pockets recently struck, which may not yield more than a ton or two of very rich quartz, by hand-pounding some 2 or 3 panfuls nearly 100 ounces of fine gold have already been obtained, and another 80 to 100 ounces of gold will easily be won from the remaining portion.

The extent of the reef to be mined and treated at present, being nearly twice of what had been at first proposed, the revised scheme as now stands is estimated to cost about Rs. 3·9 lakhs. From the portion of the reef now developed about 1,200 tons of auriferous quartz have already been mined and stacked at the surface ready for treatment and the remaining 3,000 tons are under stoping. It is anticipated that these 4,000 tons of auriferous quartz will yield at least some 2,000 ounces of gold worth, at the present market value, about Rs. 4¼ to 4½ lakhs.

There has been a considerable delay in getting the needed machinery and other appliances. Consequently, the milling and extraction of gold have not been started as yet. However, from washing the debris in the mined areas and from hand-pounding small pieces of rich quartz about 120 ounces (250 tolas), valued at Rs. 26,000-27,000, at the present market rates, have been recovered; and another 80 to 100 ounces are anticipated to be recovered during this month and the next.

Future Prospects.—The previous work of the Indian Mines Development Syndicate indicates that the Tank Reef runs north and south for a length of at least 2,000 feet and would yield some 80,000 to 100,000 tons of quartz to a depth of about 400 feet from the surface. The reef had not been traced beyond that depth since it seems to have got poorer in its gold value at that depth. Consequently, it is not known precisely how deep the reef would go, and what would be its width and value beyond the explored depth of 400 ft. The central section of the reef as now developed shows, however, that in this zone it forms, more or less, a gently undulating, tabular vein, of an average thickness of 1½ to 2½ feet, faulted and cut off abruptly at the 150-foot level. The previous workers seem to have followed downwards the thin stringer of quartz which occupies the fault line at 150-foot level. Very probably this may be a separate reef,—a later vein filling up the fault fissure, which, widening out below, might have shown low values in gold. If so, the continuation of the dislo-

cated richer reef, west of the fault line, remains yet to be discovered and traced.

The work done so far has not yet reached beyond the investigatory stage and as such it is too early to foresee whether the area will develop into a large productive mine. If, as we surmise, the previous workers had lost at the fault zone the rich shoot we are developing now and had followed in depth a much poorer reef; and if the dislocated portion of the rich shoot could be discovered and traced west of the fault zone, there is every likelihood of the area developing into a fair-sized productive mine. There are a few other auriferous reefs in the area, including the Bellara Reef, which would add considerably to the tonnage of quartz suitable for milling. Consequently, the prospects so far as one can foresee at present seem to be quite encouraging, and there is every reason to hope that the region will turn out into a thriving gold field though, perhaps, on a considerably smaller scale than the well-known Kolar Gold Field.

Geological Department,
Bangalore,
May 12, 1946.

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THE UTILISATION OF BY-PRODUCTS OF THE SHARK LIVER OIL INDUSTRY

BY

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THERE has been considerable development of late of shark fishing in the coastal waters of India on account of the shark liver oil industry which received impetus during the war from the recognition of the oil as one of the richest sources of vitamin A. The shark liver oil industry has been established in different parts on the west and east coasts (Bombay, Calicut, Travancore, Madras and other parts) and has already made promising headway. The Madras Government Department of Fisheries have started deep-sea shark-fishing and sharks are now landed on the Madras coast regularly. These belong chiefly to the species of the genera, *viz.*, *Scoliodon*, *Galeocerdo* and *Carcharias*. The survival of the industry during the post-war foreign competition should be a matter of vital concern to this country and would largely depend on the measures taken by the Central Government for the protection of the industry and for the prosecution of fundamental researches on the scientific and technical aspects. The urgent need for research on the commercial utilisation of the waste products of the industry has been appreciated by the Council of Scientific and Industrial Research which has provided funds for the investigation of shark waste and their utilisation in the chemical laboratories of the Presidency College, Madras. Gajjar and Sreenivasaya[1] in their recent communication on this subject have rightly laid stress on the national importance of the shark liver oil industry and have also presented certain data regarding the various organs and tissues of sharks which may be economically utilised as by-products of this industry. These data appear, however, to differ in many important respects from the figures obtained by us from sharks landed on the Madras coast. The sharks available on the Madras coast rarely exceed 600 lbs. in weight and the livers constitute nearly 25 per cent. of the total body weight. The only exceptions to this have been met with in the case of pregnant sharks with well-developed embryos which have been found to weigh sometimes as much as 900 lbs. The average weight of the sharks referred to by Gajjar and Sreenivasaya on the other hand, appears to be as high as 1,500 lbs. and the weight of the liver is stated to be only 3·3 per cent. of the body (*loc. cit.*). These differences are probably due to a difference in the species of sharks dealt with, as the previous authors have not specified the families of sharks from which their data pertaining to the relative weights of the various organs and tissues have been derived. We consider it useful, therefore, to present briefly a few details of the accurate figures obtained in the course of our work regarding some of the sharks caught on the Madras coast.

The commonest variety of sharks caught in this area is the *Galeocerdo tigrinus*. Sharks of this species measure from 100-150 inches in length and weigh from 300-600 lbs., and the livers constitute 20 to 28 per cent. of the weight of the whole fish. The relative proportions of the various parts of six typical specimens of these sharks are given in Table I and the average percentage weights of the different parts of seven sharks of the same species

TABLE I

(All weighings from fresh material expressed in lbs.)

No.	Length (inches)	Total wt.	Liver	Head & other cartileges	Hide	Fins	Stomach & Intestines	Blood	Muscle & other organs
1	114	316	70	65	63	12	15	3	88
2	114	290	70	60	61	9	15	3	72
3	140	507	115	110	70	15	25	3·6	168·4
4	145	507	127	104	64	15	26	4	167
5	145	545	150	118	73	14	29	4	157
6*	145	726	192	112	71	15	169	3	160

* A female shark with 38 embryos.

having an approximate length of 140 inches each is given in Table II.

TABLE II

Percentage proportions of fresh animal

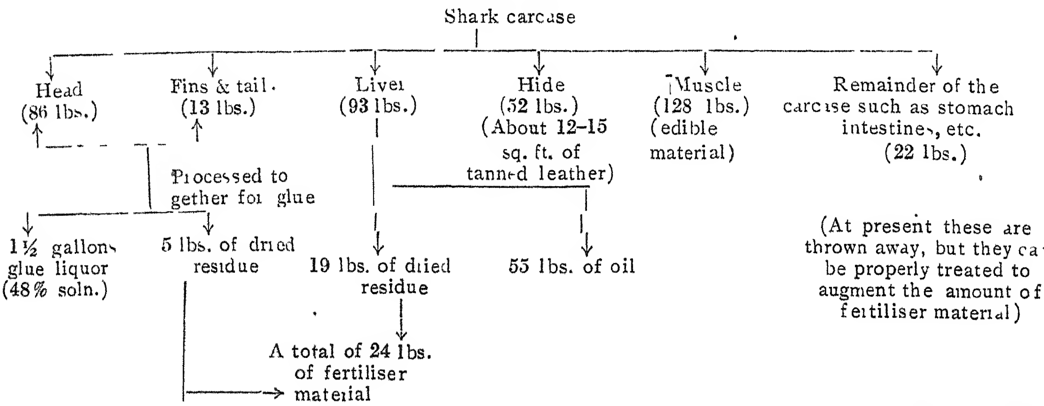
	Per cent.
Liver ..	23·3
Head and skeletal cartilage ..	21·5
Hide ..	13·8
Fins and tail ..	3·2
Heart, stomach, gills, intestines, etc. ..	5·7
Blood ..	0·8
Muscle, etc. ..	31·7

Sharks of the *Carcharias* variety which form about 20 per cent. of the sharks landed on the Madras coast are smaller, measuring on the average 80-90 inches in length, and weighing approximately 230 lbs. The average weight of the liver in these animals does not exceed 26 lbs., *i.e.*, approximately 11 per cent. of the total weight of the animal. The yield of the oil in both these species is, however, nearly the same, *viz.*, 55-65 per cent. of the weight of the liver.

The following table showing the amounts of the main products which may be obtained from a shark weighing 400 lbs. is based on the results of the preliminary work which has been carried out so far in these laboratories.

It will be evident from the table that from a shark of average weight of the *Galeocerdo tigrinus* species it would be possible to obtain 55 lbs. of liver oil rich in vitamin A, about 15 sq. feet of tanned leather, 128 lbs. (fresh weight) of edible flesh which may be filleted and smoked, 1½ gallons of good glue liquor containing 5-6 lbs. of solid matter and 24-30 lbs. of dry material of high calcium, phosphorus and nitrogen content suitable for use as fertiliser apart from the hormones of the pancreas, the thyroid and the liver residues on which work is in progress.

TABLE III



This investigation has been carried out with a grant provided by the Council of Scientific and Industrial Research to whom our thanks are due. We are also thankful to the Deep-Sea Fishing Department, Madras, for their co-operation during the course of this investigation.

1. Gajjar and Sreenivasaya, *Curr. Sci.*, 1945, **14**, 220,

THE URGE FOR WHOLENESS*

WHAT is the most basic urge or trend of human nature? Contemporary psychology gives many answers; sex, will or power, behaviour, reflex action, purpose and some other similar concepts. The variety of voices of these answers, so different and exclusive as they are, constitute the well-known crisis in the science of psychology to-day.

The question, What is really the first or fundamental urge of human nature, therefore, becomes an acute issue.

The author of this address would contend that an answer to this question can only be formulated by considering the whole phenomena of human nature in all its ranges of experience, conscious, subconscious and the super-conscious. Most of the existing answers are based upon an exclusive consideration of the nature of the subconscious or a bit of bodily behaviour or some other particular fact. The super-conscious experience testified to by vast yogic, mystic and religious literature of the world and the modern yogic practice have so far not been seriously considered by the psychologist in evolving his view of human nature. And while evolution is recognised as a fact we do not seem fully to recognise that for the understanding and explaining of a particular stage of the process the stages antecedent to it alone cannot be sufficient. McDougall affirmed "purpose" or "goal seeking" as the essential characteristic of mind, but yet resorted to searching for the antecedent facts of "structural dispositions" to explain instinctive behaviour. The natural science habit of looking for antecedents as causes seems to have influenced unconsciously even a deliberate purposivist like him.

* A popular summary of Dr. Indra Sen's Presidential Address to the Section of Psychology and Educational Science, Indian Science Congresss, Bangalore, 1946.

Indian psychology, in the opinion of the author, has been thoroughly purposivistic. To it the next higher form of consciousness possible to man has been the matter of the first importance. The end towards which an evolutionary process moves is by far the most important single factor to explain the nature of the process. The antecedents come only next to it. Indian psychology discovered and ascertained the reality of a form of consciousness, possessed of the quality of wholeness, a consciousness in which knowing, feeling and willing operate not through mutual stresses and strains and an economic balance of the whole, but through an essential unity and harmony. If such a consciousness is a reality then obviously our present view of mental action needs a radical re-orientation.

The author feels strongly persuaded to affirm that an evolving "wholeness—a tendency to a progressive perfection of organisation—is the principal trend not only of human nature but of organic evolution as a whole. This progressive perfection of organisation of life is more easily noticeable in the sub-human species, from amœba to the ape, in an increasing adaptation to and mastery of, an ever more complex environment on the whole. In man, however, the situation becomes changed. Through his power of thought he rises to an immensely greater capacity of dealing with his environment. But through the development of self-consciousness, which makes thinking possible, he becomes conscious of deep inner discords whose harmonisation becomes the new direction of evolution. Simultaneously he becomes conscious of the mechanism of projection, as a fact ingrained in his animal nature, and begins to recognise the true causes of happenings as belonging to the forces within the personality rather than to things outside. Now the yogic fact of a fulfilled consciousness, a consciousness, whole, harmonious and balanced, called by Sri Aurobindo the Psychic Consciousness, experienced and enjoyed by many individuals in the past (to that the yogic, mystic and religious literature bears wide evidence) and which to-day is equally well experienceable by pursuing an intensive inner discipline of life, comes closely in line with the fact of general human consciousness. The fact, no doubt, occurs under rather exacting conditions of life, but when once its character is definitely ascertained, its effects for general consciousness, which are tremendous, will become easier to determine. But even otherwise the quality of the fact, so distinct and unique, representing a form of consciousness, in which the so-called fundamental polarities and dualities of the general human consciousness are made good, must irresistibly draw our attention. Further the fact coming as it does in the wake of the divided general human consciousness, obviously becomes the more powerful single consideration in support of the hypothesis that human nature as also organised evolution generally present a picture of a self-evolving wholeness. In other words, what is basic to human nature and towards which it is tending is a form and status of fully organised consciousness in which its present polarities are harmonised and reconciled. But this tendency to wholeness appears to be marked by the experimental procedure, so that within the framework of general progression it becomes possible for individual men or species in the sub-human level to show signs of fixation, regression or any other form of deviation from the normal behaviour.

Among contemporary psychologists, it is interesting, we discover many direct and indirect recognition of the fact of a whole and a harmonised consciousness. Even in Freud, who picked up polarities after polarities in human nature and made most of them ultimate to human nature, we read such a sentence as this: "It can be easily imagined that certain practices of mystics may succeed in upsetting the normal relation between the different regions of the mind, so that for example, the perceptual system becomes able to grasp relations in the deeper layers of the ego and in the id, which would be otherwise inaccessible to it." Dr. Bose, the most eminent psychoanalyst of our country, while carrying the idea of polarity to the extent of posting a counter-wish to every wish, affirms himself to be a believer in "pure consciousness as distinguished from consciousness of this or that." Further in his theory of mind he finds it necessary to admit a principle of unity as the "guiding principle" of all mental action. This principle according to him, reconciles the last polarity of subject and object.

Dr. Mitra's hypothesis regarding the nature of mind possesses an obvious similarity to the view here defended, as he assumes that mind, to start with, is "in a state of perfectly stable equilibrium quite content and at harmony with itself. However, for us, such equilibrium is the evolutional goal, not the starting point.

McDougall too contemplates a fully integrated personality under a single master sentiment.

However Jung stands above all in having perceived clearly and distinctly the force and the power of the psychic consciousness. He finds the ordinary psychological explanation of personality as "inappropriate" and guided by his principles of analytical psychology discovers a truly unique fact in personality. This he calls, the "centre" or "self". To activate the centre and live in the consciousness of the self is to live the life of wholeness. This consciousness is creatively synthetic, as it assimilates the disparate materials of our mental nature and reshapes them into the picture of wholeness. All this perception is superb. Yogic practice too, at its best, aims at nothing else but the activation of the psychic centre or the soul in its dynamic aspect.

But while the recognition of a unique centre is fine, Jung did not see that the consciousness of the centre, marked by a sense of wholeness, constitutes a higher plane than the ordinary mental consciousness. In consequence he mixed up the super-conscious with the subconscious and declared the *Samadhi* state a state of unconsciousness.

The hypothesis here presented thus commands an appreciable direct and indirect support from contemporary psychology. But it

primarily relies upon its own strength and merit. It offers a theory of mind based upon the widest data of conscious phenomena, since it takes into consideration the evolutional progress as a whole from the earliest beginnings to the stages, which yet set the goal to the present human consciousness. It gives a coherent explanation of the normal and the abnormal consciousness. Above all, it gives a clear scientific meaning to the concept "normal" and saves the term from being a changing social average. Lastly, affording a fuller perspective of mental life, it is capable of reconciling the conflicting standpoints of the schools of contemporary psychology. The fact of psychic consciousness is a supreme fact for psychology as it presents a form of consciousness higher than the mental and is, therefore, capable of showing the true sphere of validity of the terms of our ordinary consciousness. Sex, will power, etc., cease to have the validity they ordinarily possess for the psychic consciousness. The urge for wholeness, the trend towards a fuller organisation and harmony of life, as shown by the psychic consciousness, therefore, is the most basic trend of human nature. The other answers, possessing a partial validity as they do, can be accommodated as particular instrumentations of the trend towards wholeness.

Indian psychology has indeed a great promise but the value of its peculiar standpoint and the facts discovered by it have yet to be appraised by us for the benefit of our modern psychological knowledge.

SOYA BEAN*

SOYA BEAN as a foodstuff holding high promise has received wide attention in India, but mostly at the hands of well meaning social workers imbued with more spirit than knowledge. To them soya bean appeared to be the panacea for all evils in India arising out of underfeeding and malnourishment. They have been encouraged in this belief by a certain section of scientific workers who took every article published in scientific, semi-scientific or popular journals outside India as gospel truth.

Soya bean was already an established article of diet in China and some other countries of the Far East before its introduction to Europe and America. The Americans have been particularly responsible for bringing its nutritive value to the notice of the rest of the world during recent years. Its high protein and fat content formed the bedrock on which nutritive value of soya bean was based. It was naturally thought that the deficiencies of Indian dietaries could be made good by soya bean. Humanitarian enthusiasts have tried to bring its good points before the public and the authorities with a view to initiating and encouraging cultivation and popularisation of the soya bean in India.

Although some varieties of soya bean grow along the northern border of India, it cannot strictly be called indigenous in the sense that the pulses and other beans are. Sporadic attempts have been made to grow it as a food (or cash) crop in India. The Agricultural Department of the Government of India also had to consider whether the production of soya bean in this country deserved encouragement for purposes of human consumption.

In the meantime soya bean was engaging the attention of scientific workers in this country. Unfortunately there were two irreconcilable schools of thought holding divergent views. In 1941 the Nutrition Advisory Committee of the Indian Research Fund Association (which is also the National Nutrition Advisory Committee with the Government of India) finding itself unable to compose the differences by discussion across the table appointed a Sub-Committee consisting of Dr. W. R. Aykroyd, Dr. K. P. Basu, Prof. B. C. Guha, Dr. V. N. Patwardhan and Dr. K. C. K. E. Raja, to suggest lines on which further experiments on soya bean might be carried out by different laboratories, with a view to provide an answer to the question, "Whether the nutritive value of soya bean in comparison with those of common Indian pulses is such as to justify from the standpoint of human nutrition, the encouragement of the production and consumption of soya bean on a wide scale in India".

The results of the co-ordinated investigations carried out in the four laboratories at Bombay, Coonoor, Dacca and Lahore under the auspices of the Sub-Committee have recently been published as a Special Report (I.R.F.A. No. 13). The investigations mainly dealt with (*a*) the biological value of soya bean and pulse proteins, (*b*) the effect of heat treatment on the nutritive value and (*c*) the supplementary value of soya bean and pulses to the so-called poor *Madrasi diet*. Although most of the work was done on albino rats some experiments on human beings were conducted as well. An account of most of the earlier work on soya bean has also been included in the report.

The biological value and digestibility coefficient of the soya bean protein by growth and metabolic studies on albino rats and in human beings were found to be of the same order as those of the other pulses. In spite of its high available protein content (1½ to 2 times that of pulses) soya bean did not prove any better than the common Indian pulses as a supplement to the poor rice diet. In most experiments Bengal gram seems to have given better results than even soya bean. Incidentally it has been found that the so-called "poor Madrasi" diet suffers more from a lack of minerals and vitamins than from that of proteins.

After four years of work the Soya Bean Sub-Committee came to the conclusion "that as a supplement to typical Indian diets based on

* "Report on Soya Bean," by the Soya Bean Sub-Committee of the Nutrition Advisory Committee, Indian Research Fund Association, Jan. 1946, p. 35. Price As. 8 only.

cereals, but supplied in adequate quantity, soya bean has no special advantage over common Indian pulses". Finally the Sub-Committee states that "it is not in a position, therefore, to advocate *immediately* the encouragement of the production of soya bean on a wide scale in India for use as a substitute for Indian pulses".

One point connected with soya bean, however, would appear to need further consideration; it pertains to what is known as "synthetic" milk. One of the methods of processing soya bean for human consumption is to prepare a milk-like fluid from it. Soya bean is softened by steeping for varying periods in warm water and is then ground with further addition of water. When coarse particles are removed by sieving an emulsified fluid is left behind. The emulsion thus obtained looks like milk and in composition varies according to (*a*) the method of preparation and (*b*) the quantity of water added. For ages, "soya milk" thus prepared has been used in China; the main reason for its extensive use in certain regions in China is the almost complete absence of cow's milk from the prevalent human dietary. The soya emulsion prepared as above is inferior even after fortification with salts and vitamins in nutritive value as compared with fresh whole milk. There could be no doubt that an emulsion from the germinated bean would give a preparation with a greater nutritive value as compared with that obtained from untreated beans. There is little proof, however, to show that it approaches cow's milk, although it may appear to be so by virtue of its chemical composition; this is a crude way of comparing two biologicals. The I.R.F.A. Report makes it clear that all the available evidence points to the conclusion "that soya bean preparations, if fed to infants, need to be supplemented by minerals and vitamins and that even after such supplementation they are less satisfactory than breast milk or cow's milk".

The only acceptable proof of the value of soya emulsion in human nutrition should be forthcoming from suitably designed and rigorously controlled experiments on human beings. Conclusions based on other considerations, such as chemical composition, effects on experimental animals, etc., would still fail to provide the decisive proof which is absolutely essential if the question is to be settled to the satisfaction of all.

The Indian Research Fund Association deserve to be congratulated not only for providing an authoritative report on the vexed question of soya bean, but also for demonstrating an effective way through which controversial issues in the field of scientific endeavour could be authoritatively settled.

NATIONAL AIRCRAFT INDUSTRY FOR INDIA

THE Government of India have decided to establish a National Aircraft Industry in India, with a 20-year target of complete self-sufficiency, for building aircraft needed for the Royal Indian Air Force as well as for civil aviation. The decision is based on the recommendation of the United Kingdom Aircraft Mission which was invited to India in March 1946. The report will be released as soon as arrangements for its printing can be made.

The Mission consisted of Messrs. J. V. Connolly and L. R. Barrett from H.M.G.'s Ministry of Supply and Aircraft Production and Messrs. J. D. North and S. P. Woodley of the Society of British Aircraft Constructors. Arriving in India on March 25, they made a rapid, but intensive survey of the potentialities for the manufacture of aircraft and its ancillary products. They visited the aircraft repair and maintenance factories at Barrackpore, Poona and Bangalore as well as the Ordnance factories at Cawnpore, Cossipore and Jubbulpore.

After examining the three sites at which aircraft repair and maintenance had been carried on during the war—at Barrackpore, Poona and Bangalore—the Mission recommended that aircraft production should, initially, be started in the Bangalore factory, as it is the only one which is still a working aircraft unit, has the longest experience of aircraft work and the greatest number of staff and operatives experienced in working as a team on aircraft production. It has to its credit the design, execution and successful flight of an entirely original prototype glider. Moreover, research and training facilities are available closeby at the Indian Institute of Science at Bangalore.

Due to the comparatively small initial demand for aircraft, only one factory is recommended in the first instance; but at a later stage of development, production may be started at other centres.

The Mission attach particular importance even at the initial stage to the designing of aircraft, as only by this means will the necessary confidence and skill be obtained by Indian staff. The Government have accordingly decided that the design of an original prototype aeroplane specifically suited to Indian conditions should be taken up immediately.

The Mission have given a detailed report on some aspect of technical training including that available at the Indian Institute of Science, Bangalore; and also on labour training. They consider the facilities available at Bangalore promising and have suggested ways and means for their development and co-ordination with the requirements of the industry.

The Government have decided that steps should be taken forthwith for the production of trainer aircraft required for the R.I.A.F. It is anticipated that the first aircraft will come out of the Indian factory in less than 18 months from now.

The size of Hindustan Aircraft Ltd. makes some complementary manufacture side by side with aircraft production desirable during the first quinquennium. The passenger coach project has been recommended as eminently suitable by the Mission. The Railway Department are prepared to place orders for coaches for the next five years subject to the type and price being found satisfactory. Their first order will be for 100 coaches, which is understood to be the maximum yearly capacity of the factory.

LETTERS TO THE EDITOR

A NEW CATALYTIC REACTION IN THE VAPOUR PHASE: ALLYL ALCOHOL FROM GLYCERINE

In the course of our investigations in the vapour phase catalytic decomposition of glycerine, the formation of allyl alcohol in good yields in a single stage conversion was observed in a reducing atmosphere, the other products being polyglycerol and water.

The decomposition of glycerine has been studied by Sabatier and others[1,2,3] over dehydration catalysts. Sabatier observed acrolein, polyglycerols and gases during decomposition over Al_2O_3 and anhydrous $MgSO_4$, etc., at 360° C. In Sabatier's study of glycerine decomposition over copper powder[4] at 330° C., traces of allyl and ethyl alcohols were reported to have been obtained.

The well-known preparation of allyl alcohol from glycerine and oxalic or formic acid was first described by Chattaway.[5] The oxalic or formic acid reacts with glycerine to form the monoformin, which is next decomposed into allyl alcohol with 45 per cent. yields of alcohol on glycerine used. Since the acids are lost due to reaction, the method is prohibitive in cost. The commercial processes for manufacture of allyl alcohol utilise propylene from natural gas. In a new Shell Development Company's process[6] propylene is selectively chlorinated to allyl chloride which is subsequently hydrolysed to allyl alcohol:

$$CH_2 = CH - CH_3 + Cl_2 \longrightarrow CH_2 = CH - CH_2 - Cl + HCl.$$

$$CH_2 = CH - CH_2 - Cl + NaOH \longrightarrow CH_2 = CH_2 - OH + NaCl.$$

Another patent[7] describes the oxidation of propylene to propylene oxide, the epoxide in turn being isomerised into allyl alcohol over alum catalyst:

$$CH_2 = CH - CH_3 \xrightarrow{+ O_2} \underset{\diagdown O \diagup}{CH_2 - CH} - CH_3 \xrightarrow{\text{Alum}} CH_2 = OH - CH_2 - OH$$

In the present investigation, the glycerol conversion was studied at atmospheric or sub-atmospheric pressures at temperatures of 300° C.-600° C. over catalysts with a reductant like CO. A maximum yield of 16 per cent. allyl alcohol on glycerine converted was got at 300° C. over a catalyst (F_1) composed of a dehydrating component (A) and a deoxygenating component (B). A few representative data for the different catalysts tried at optimum temperatures are given in Table I.

The products contain allyl alcohol, polyglycerol and water. Polyglycerols are formed due to flash heating of glycerine and could be reconverted into glycerol.[8] Only minute traces of aldehyde (presumably acrolein) were detected with Fuchsine reagent. Allyl alcohol was tested according to Denige's method[9] and estimated by the bromide-bromate method recommended by Stritar.[10]

The following scheme illustrates the possible course of reaction on the catalyst surface:—

$$\begin{array}{l} CH_2 - OH \\ | \\ CH - OH \\ | \\ CH_2 - OH \end{array} \xrightarrow{\text{over component (A)}}$$

$$\left.\begin{array}{l} CH_2 - OH \\ | \\ CH \\ | \\ CH_2 \end{array}\right\rangle O \xrightarrow[\text{component (B)}]{+ \text{ CO over}} \begin{array}{l} CH_2 - OH \\ | \\ CH \\ \| \\ CH_2 \end{array} + CO_2$$

The formation of glycide over the dehydration catalyst was confirmed. The breaking of the epoxide as shown above is not in conformity with Krautskii's rule[11] and has no parallel in literature. Yet the reaction may occur through the interaction of a loose carbonyl-complex and its subsequent dissociation on the catalyst surface.

Now that the war is over, glycerine in India is in excess supply. Its conversion into allyl alcohol which is an important ingredient for plastics may be a commercial possibility.

TABLE I

Catalyst	Temperature °C.	% yield of allyl alcohol on glycerine passed	CO increase in c.c. contact gas, %	Allyl alcohol/gm. catalyst/hr.
A-1	320–350	3·6–4·5	less than 1·0	·24
B-1	280–300	5·7–6·9	nearly 1·0	·36
C-01	340–360	5·1	1·5	·306
C-1	230–250	6·3	2·1	·39
F-1	300–310	16·9	9·5	1·02

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CHEMISTRY OF KURCHI SEEDS: PART II.[1] ISOLATION OF THE BROMIDE OF A LINOLEO-DILINOLENIN FROM THE FATTY OIL

THE fatty acids of Kurchi seed oil (*Holarrhena antidysenterica*) have been shown in these laboratories[2] to consist of linolenic (10 per cent.), linolic (54·7 per cent.), oleic (21 per cent.) and saturated acids (14·3 per cent.). But the arrangement of these in the molecules of the component glycerides has not been investigated so far. The present work is a contribution in this direction.

The glyceride structure of fats has been extensively studied in recent years by Hilditch and others[3] employing a fairly simple technique for the direct estimation of fully saturated triglycerides. Unfortunately, the estimation of other classes of glycerides, especially of unsaturated glycerides rests upon uncertain and less reliable methods.[4] It is not surprising, therefore, that the commonly accepted rule of "even distribution of fatty acids in mixed triglycerides" has shown marked deviations as a result of more careful recent work.[5]

For the estimation of glycerides containing unsaturated acids, the method of addition of bromine to the oil in a suitable solvent, followed by isolation of the crystalline mixed bromoglycerides has been adopted by previous workers.[6,7] But this procedure has not proved suitable for a quantitative estimation.

Adopting the bromination method, 24·5 gm. of kurchi seed oil dissolved in 110 c.c. of ether (dried over sodium) and cooled to about 5° C. yielded 10·5 gm. of an insoluble bromide melting at 107-13°. After washing this with a mixture of methyl alcohol and ether, 7·2 gm. (m.p. 116-18°) were obtained. Crystallisation of this from a mixture of absolute alcohol and benzene gave 2·1 gm. of white granular crystals melting at 154° (sharp). The bromine content of this, estimated by Stepanow's method, in duplicate, was found to be 58·2, 58·2, agreeing closely with the theoretical value (58·9) for the bromide of linoleo-dilinolenin.

The occurrence, therefore, of a linoleo-dilinolenin in kurchi seed oil, in spite of the low content of linolenic acid is one more deviation from the rule of even distribution quoted above. The work is being continued.

I am thankful to Mr. P. Ramaswami Ayyar for suggesting the problem and giving guidance, and to Dr. P. C. Guha for kind interest.

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ELIMINATION OF THE NITRO GROUP IN THE PROCESS OF DIAZOTISATION OF 2, 5-DICHLORO-4-NITRO-ANILINE

IN order to place beyond doubt the constitution of a tetrachlorobenzidine prepared from 2, 5-dichloro-nitrobenzene by electro-reduction, a synthesis of the substance was planned from 2, 5-dichloro-4-nitro-1-iodobenzene (I) as the starting material by Ullmann's method. The obvious method of preparing the latter substance would be the diazo replacement by iodine of the amino group in 2, 5-dichloro-4-nitro-aniline (II). On attempting the reaction, however, by the usual method of treating an ice-cold solution of the amine in acetic and hydrochloric acids with sodium nitrite and then adding potassium iodide to the clear

diazonium solution and heating, a nitrogen-free product melting at 105° (III) was obtained instead of the expected compound (I).

The new compound (III) was found to contain iodine and to be non-phenolic. Its structure as 2, 4, 5-trichloro-1-iodo benzene was established by coupling the diazo compound obtained from (II) with β-naphthol in alkaline solution and reducing the deep red azo dye (m.p. 197°) with stannous chloride and hydrochloric acid, when a mixture of 1-amino-2-naphthol and 2, 4, 5-trichloro aniline were obtained. The latter was separated by extraction with benzene in alkali and its identity established in the usual manner (m.p. 96°; acetyl derivative m.p. 190°).

The replacement of a nitro group by chlorine during the process of diazotisation of a nitro-amine was first observed by Meldola and Eyre[1] in the case of 2, 3-dinitro-4-methoxy aniline. On the basis of an extended study of such cases, Meldola *et al.*[2] laid down certain conditions for such elimination to occur, *viz.*, that (*a*) the nitro group displaced should be either in the ortho or the para position to the diazo group and (*b*) there should be a second nitro group adjacent to the one which is knocked off. The observation that the displacement of the nitro group can take place even when there is no second nitro group but only a chlorine atom adjacent to itself does not appear to have been recorded in literature. In the present instance, the problem is complicated to some extent by the presence of a second chlorine atom in the meta position to the nitro group which is knocked off. In accordance with the observations made by Kenner[3] that an ortho-para-orienting group such as chlorine has the power to labilize groups in the meta position with respect to itself, the probability is not ruled out that the second chlorine atom has also some influence in bringing about the displacement of the nitro group. While the relative shares of influence exerted by the two chlorine atoms can be determined only by further investigations in this field, it is permissible in the light of the observations made so far, to extend the postulate of Meldola and others by stating that the second group adjacent to the group displaced need not be a nitro group but may also be a chlorine atom.

It has been found that if the diazotisation of (II) is carried out in the absence of hydrochloric acid by dissolving the amine in acetic and sulphuric acids, there is no disturbance of the nitro group and the desired iodo derivative (I, m.p. 84°) could be prepared in excellent yields (80 per cent.). That the reaction proceeds in these circumstances in the normal manner without elimination of the nitro group has been further confirmed by coupling the diazo compound with alkaline β-naphthol and reducing the resulting azo dye (m.p. 236°) with stannous chloride and hydrochloric acid, when 2, 5-dichloro-1, 4-diamino benzene (m.p. 168°; acetyl derivative m.p. 296°) was obtained, besides 1-amino-2-naphthol. A similar observation has been made[4] with 1-nitro-2-amino naphthalene where the nitro group is replaced by chlorine when the diazotisation is carried out in the presence of hydrochloric acid, although no such replacement occurs if sulphuric acid is used instead.

Fuller details of this investigation will be published elsewhere in due course. Our thanks are due to the Council of Scientific and Industrial Research under whose auspices this work has been carried out, for their kind permission to publish the results.

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SOLVENT EXTRACTION IN A SPRAY COLUMN

In view of the growing importance of counter-current liquid-liquid extraction, as a Chemical Engineering unit operation, the study of the performance of the different types of continuous extraction columns was undertaken with the system nitrobenzene-acetic acid-water and some data on extraction in a 1·36″ diameter glass spray column are given below. It is proposed to continue the study in packed and sieve-plate columns and the entire paper will be published elsewhere.

The equilibrium distribution data at 25° C. for the system nitrobenzene-acetic acid-water were taken from literature.[1] The results are expressed in terms of the overall extraction coefficient $K_N a$ and the corresponding $(H.T.U.)_{ON}$ based on the nitrobenzene phase since the nitrobenzene film offers the major resistance to acid transfer.

Table I shows the effect of changing the inlet acid concentration of nitrobenzene on $K_N a$ and $(H.T.U.)_{ON}$.

TABLE I

Nitrobenzene flow rate = 29·0 cu. ft./hr./sq. ft. tower cross-section.
Acid solution flow rate = 26·9 c. ft./hr./sq. ft. tower cross-section.
Extraction height = 3 feet.

Inlet acid concen. of Nitrobenzene in lb.mols / cu. feet	Inlet acid-concen. of acid solution lb. mols./cu. ft.	Nitrobenzene dispersed		Acid dispersed	
		$K_N a$	$(H.T.U.)_{ON}$	$K_N a$	$(H.T.U.)_{ON}$
0·000024	0·04258	7·8	3·7	9·6	3·0
0·000475	,,	8·1	3·6	9·4	3·1
0·001304	,,	7·4	3·9	9·8	3·0
0·001728	,,	9·6	3·0	12·2	2·4

Table II shows the effect of changing the inlet acid concentration of nitrobenzene on $K_N a$ and $(H.T.U.)_{ON}$.

TABLE II

Nitrobenzene flow rate = 20·1 cu. ft./hr./sq. ft. Acid solution flow rate = 26·5 cu. ft./hr./sq. ft.
Inlet acid concen. of Nitrobenzene : Traces (0·000041 — ·000062 lb. mols./cu. ft.)

Height of column in feet	Nitrobenzene dispersed						Acid dispersed					
	Inlet acid concentration of acid solution lb. mols./cu ft.											
	·0205		·0737		·1123		·0205		·0737		·1123	
	$K_N a$	$(H.T.U.)_{ON}$	$K_N a$	$(H.T.U.)_{ON}$	$K_N a$	$(H.T.U.)_{ON}$	$K_N a$	$(H.T.U.)_{ON}$	$K_N a$	$(H.T.U.)_{ON}$	$K_N a$	$(H.T.U.)_{ON}$
3·0	6·5	3·1	6·3	3·2	6·3	3·2	[illegible]·1	2·5	8·0	2·5	8·0	2·5
2·0	5·9	3·4	5·9	3·4	6·8	3·0	8·0	2·5	8·5	2·4	9·5	2·1
1·0	7·5	2·7	7·3	2·8	9·2	2·2	11·1	1·8	11·7	1·7	12·3	1·6
0·5	12·1	1·7	12·8	1·6	12·9	1·6	14·4	1·4	14·6	1·4	13·2	1·5

From the above it can be concluded (*i*) that $K_N a$ remains more or less constant with the increase in inlet acid concentration of either solvent, (*ii*) that there is a progressive increase in $K_N a$ and a corresponding decrease in $(H.T.U.)_{ON}$ with decrease in extraction height and (*iii*) that the values of $K_N a$ and $(H.T.U.)_{ON}$ become almost identical at 0·5 feet for the two phases dispersed, though for the other extraction heights $K_N a$ is always more and $(H.T.U.)_{ON}$ less, for the acid phase dispersed.

From the amount of solute extracted expressed as a percentage of the total extraction in a 3 feet column, it is seen that about 45 per cent. of the total extraction taking place in a 3 feet column, occurs within 6 inches of the column, showing that appreciable extraction takes place as the drops are formed from the spray nozzle.[2]

We have great pleasure in acknowledging our deep gratitude to Sir J. C. Ghosh for his valuable suggestions and help during the course of this experiment.

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ELECTROLYTIC REDUCTION OF META-DINITROBENZENE TO 2, 4-DIAMINOPHENOL

2, 4-DIAMINOPHENOL salts are used extensively as photographic developers under various trade names such as "Amidol", "Diamol", "Dolmi", etc. The technical preparation of this valuable photographic chemical is commonly carried out by reducing 2, 4-dinitro-phenol either with a metal and acid or electrolytically.[1] The only reference in literature to the direct production of the diaminophenol from meta-dinitrobenzene by electrolytic reduction is that of Gattermann[2] who obtained it by electrolysing a solution of meta-dinitrobenzene or meta-nitraniline in concentrated sulphuric acid using a platinum cathode. The yield obtained, however, is not specified.

The preparation of para-amino-phenol in nearly 70 per cent. yield by the electrolytic reduction of nitrobenzene in dilute sulphuric acid emulsion using a copper or monel cathode and a suitable catalyst has already been reported from this laboratory.[3] A study of the electrolytic reduction of meta-dinitrobenzene in sulphuric acid emulsion on similar lines was undertaken sometime ago with special reference to the influence of such factors as strength of acid, concentration of depolariser, composition of cathode material, current density, catalyst, etc., on the nature and yield of the products. 2, 4-Diaminophenol has now been obtained in a yield of nearly 50 per cent. by electrolysing an emulsion of meta-dinitrobenzene with 40 per cent. sulphuric acid at either monel or copper cathodes using a suitable catalyst and a current density of 5 amps. per sq. dm. While further experiments are in progress for improving the yield, it may be said that the results obtained so far promise to serve as a convenient basis for the technical manufacture of this important chemical.

Bradt and Brown (*loc. cit.*) have used the ordinary method of estimation of amino-groups with sodium nitrite for computing their yields of diaminophenol—an obviously unreliable method, considering the fact that the estimation was carried out in a mixture in which other amino-compounds might be present. Indeed meta-phenylene-diamine in varying amounts was always found to accompany the diaminophenol in our experiments so that the method of procedure of the previous authors for calculating the yields of diaminophenol is definitely ruled out. Fortunately, 2, 4-diamino-phenol is found to form a very sparingly soluble oxalate[4] with the aid of which an almost quantitative separation of the pure product is possible. The over-all yields of diaminophenol obtained in our experiments have always been calculated from the weights of the pure dry oxalate.

Fuller details of the investigation will be published elsewhere in due course. Our grate-

ful thanks are due to the Council of Scientific and Industrial Research for kind permission to publish the preliminary results.

Presidency College, Madras, B. B. DEY.
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THE CHROMOSOME NUMBER IN *TORULA UTILIS*

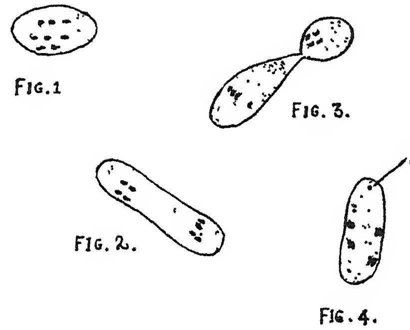
RECENTLY much work has been done on the cytogenesis of *Saccharomyces cerevisiæ*. Since *Torula utilis* is of great importance in the vitamin B industry, a study of its cytology is important.

The strain of *Torula utilis* used was one maintained in the laboratory, originally obtained from Dr. A. C. Thaysen, Chemical Research Laboratory, Teddington, and sent by Dr. M. Qureshi, Director, Central Laboratories, Hyderabad (Deccan). The strain was grown for this work both in liquid and solid media. To get smears of actively dividing cells and of the same stage fresh cultures were used.

Smears of this organism were treated with several routine fixatives and stains, but the best fixative proved to be Carnoy. Of the several stains used, Toluidine blue[1] gave excellent results as was suggested to us by Srinath's communication.[2] Heidenhain's hematoxylin, however, did not give satisfactory results. Fresh smears were fixed in Carnoy's fluid for 45-60 minutes, then removed to absolute alcohol. The smears were brought to water, passing through grades of alcohol and kept in one per cent. aqueous Toluidine blue for 30 minutes. Previous workers do not mention to that effect but we find in order to get good results fresh Toluidine blue solution is essential. The smears were washed in water and were differentiated in 50 per cent. acid alcohol. Finally the smears were cleared in clove oil and kept in xylol for a few minutes and mounted in neutral balsam.

In a well-stained and differentiated smear chromosomes are stained deep pink and the ground cytoplasm light blue. It is interesting to note how in this organism the division and arrangement of the chromosomes takes place. There is dispute as to how the nucleus of the yeast divides during budding.[3] The nucleus of *Torula utilis* divides mitotically and it has been observed that the chromosomes split longitudinally. After the preliminary divisions of the nucleus in a budding cell, eight chromosomes are seen scattered as in Fig. 1. After this stage the cell elongates and four chromosomes on either side begin to separate as shown in Fig. 2. Then a constriction is formed as in Fig. 3 and the organism divides into two with four chromosomes in each.

It has been observed in some cells that in addition to eight chromosomes two more bodies are also seen. These bodies are different in shape and size. Further Toluidine blue stains them lightly as compared with chromosomes. These two extra bodies are identical with each other and are found always aloof from the chromosomes and are often seen towards the poles of the budding cell as shown in Fig. 4 c. As we know that the shape and size of the chromosomes are genetically controlled, so the two extra bodies may be regarded as centrioles.



X 1200.

This work was done in Prof. S. Mahdihassan's Laboratory. We are much thankful to him for his active interest and guidance.

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May 20, 1946.

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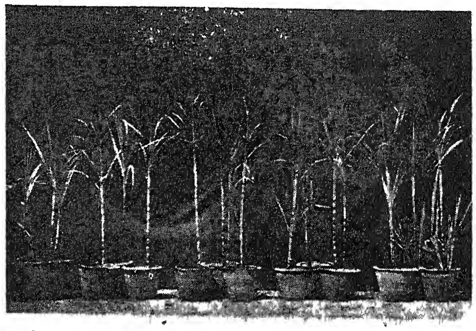
INDUCING FLOWERING IN NON-FLOWERING SUGARCANES

IN certain sugarcane varieties flowering is not normal, the reproductive phase being very often completely suppressed or only partially expressed showing all types of sexual degeneration and arrested floral development. It often happens that a variety which should otherwise make an excellent breeding material fails to flower at the Breeding Station. In the past little evidence has been produced to show that persistently non-flowering cane varieties could be induced to flower. In a previous note[1] a brief account was given of the results of investigation into the photoperiod factor in relation to flowering in sugarcanes. The close relationship existing between the two was emphasised and certain treatments were suggested for inducing flowering and delaying the times of flowering. The sugarcane varieties, however, differ greatly in their photoperiodic requirements and that

makes it necessary to tackle the varieties individually and evolve a different photoperiodic treatment for each one of the numerous varieties which do not flower at this Station, which is obviously not easy to achieve, considering the expense and difficulties involved in manipulating the photoperiod under field conditions. In the hope of evolving a practice that could be more easily manipulated, another line of investigation was pursued and studies were made into on the effects of manuring and irrigation on flowering in sugarcane. Baretto[2] studied the flowering behaviour of several cane varieties and he concluded that the factors influencing the flowering of sugarcane are unknown. He, however, observed that in the years of copious rainfall flowering may become pronounced in the varieties P.O.J. 2714, P.O.J. 2878 and P.O.J. 2882. Evans[3] made various experiments on arrowing in sugarcane and he found that heavy applications of phosphates or nitrates inhibit arrowing in this plant. Recently Kerr[4] observed that where the cane received no sulphate of ammonia fertilizer the percentage of arrowed stalk was 71, when 200 lb. sulphate of ammonia and 400 lb. sulphate of ammonia per acre had been applied the percentages of flowering were 54 and 11 respectively.

It is the usual practice at this Station to manure the cane fields with a mixture of ammonium sulphate and groundnut-cake in three doses, at planting, at three months and at six months. The total quantity of the manure applied is 240 lb. ammonium sulphate and 2,600 lb. groundnut cake per acre. To see if manuring at this rate in any way inhibited flowering in cane varieties, a preliminary pot-culture experiment was run in 1943 with two non-flowering North Indian types, *viz.*, Baroukha 13 A and Sewari. Ten plants from each of the two varieties were grown in large-sized pots containing the ordinary garden land soil, each pot supporting one plant. Four plants from each variety were manured with a finely powdered mixture of ammonium sulphate and groundnut cake, in two doses, at three months and at six months. Each dose consisted of 2 gm. ammonium sulphate and 10 gm. groundnut cake. The remaining plants were kept unmanured. It was observed that eight months after planting the unmanured plants of both the varieties came to flower and striking feature was that each tiller of these plants was in flower. The manured plants grew vigorously but did not show any sign whatever of flowering. These results were confirmed in 1944 and it was further observed that certain varieties like P.5649 flowered when manuring was reduced from the usual three doses to the two initial doses, applied at the first month and the third month (Fig. 1). Some varieties such as P.4626 flowered best when manuring was reduced to a single initial dose at planting; while some others flowered only when no manure was applied. Heavy doses of manure—ammonium sulphate and groundnut cake—applied at fourth and seventh month, delayed and inhibited flowering even in such profusely flowering varieties as Co.421. In certain cases one heavy dose of manure applied at sixth or seventh month was found enough to completely inhibit flowering.



No manure | 1 dose manure at planting | 2 doses manure at planting & at 3 months | 3 doses manure at planting at 3 months & 9 months | 1 dose manure at 7 months

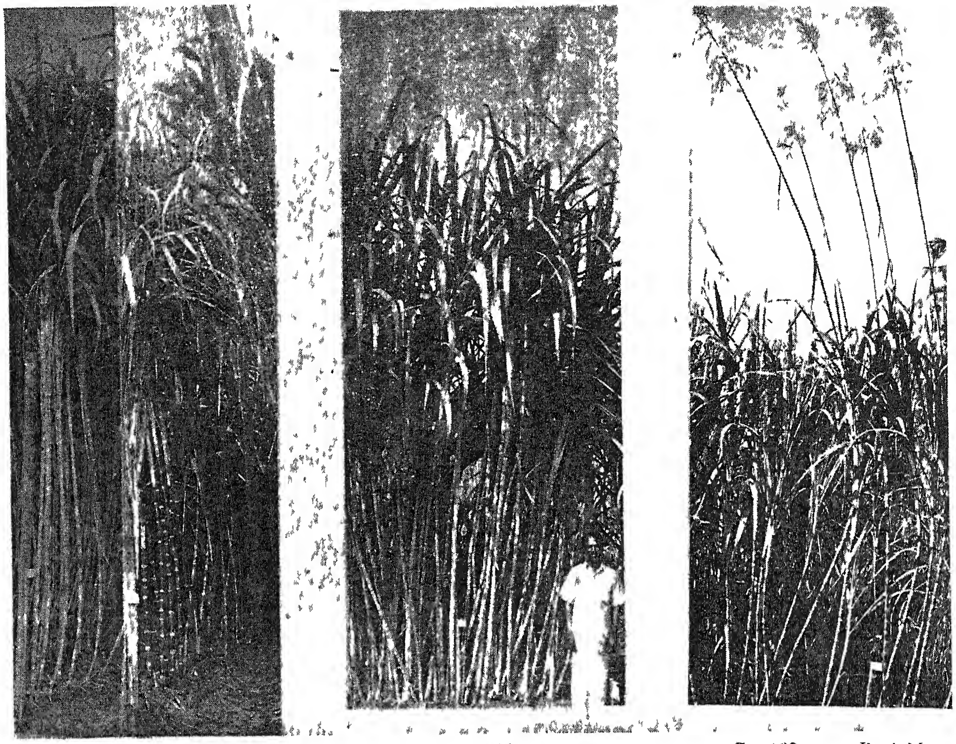
FIG. 1. Showing the effect of manuring (Amm. Sulphate + G. N. Cake) on flowering in the cane variety P. 5649.

The field tests carried out simultaneously showed that besides manuring, irrigation was another important factor very closely concerned with flowering in sugarcanes. Thus when irrigation was increased to twice that of the normal, certain non-flowering varieties like Red Mauritius and Nargori 15 D, came to flower and as the water supply was further increased to alternate day and daily irrigation even such persistently non-flowering varieties as Co.468 flowered. To gain further information on the two factors, manuring and irrigation, in regard to flowering, a more comprehensive experiment was laid out in the beginning of the year 1945. Seven varieties, *viz.*, Red Mauritius, Co.468, P.5649, Poovan, S.s. Assam (301), B.3013 and P.4626, were used in this experiment and several conditions of manuring and irrigation were studied. The success achieved was phenomenal and six out of the above-mentioned seven varieties were induced to flower. The results are briefly described below.

The flowering season at Coimbatore commences in the beginning of October and it continues to the middle of December. Red Mauritius and Co.468, the two important thick cane varieties, which are not known to flower at this Station, flowered profusely with the treatment of alternate day irrigation; about 70 per cent. and 72 per cent. of the stalks flowered, respectively. Only a light initial dose of the mixture—bonemeal and groundnut cake—was applied to these plots. The controls, which received usual three doses of the mixture—ammonium sulphate and groundnut cake—and normal irrigation, *i.e.*, once a week, did not show any sign of flowering (Fig. 2).

P.5649, another non-flowering thick cane variety, flowered only when subjected to daily irrigation conditions from July to September, a period of three months prior to commencement of flowering season. It gave about 40 per cent. of flowering.

Poovan, which is still another important non-flowering thick cane variety, and S.s.



Red Mauritius Co.468 Co 468 Red Mauritius

Treated (alternate day irrigation) Control

FIG. 2. Showing the effect of irrigation on flowering cane varieties.

Assam 301, a non-flowering wild form, gave the best results with the treatment of daily irrigation throughout the growth period and a single initial manuring with bonemeal and groundnut cake, at planting. The flowering, however, was not profuse but half a dozen of healthy arrows were in each case available for crossing purposes. The controls of these varieties did not show any sign of flowering.

The variety P.4626, which is late and sparsely flowering, flowered early and very profusely with the above treatment of daily irrigation. The arrowing commenced in the beginning of October and by the end of October about 50 per cent. of the stalks had arrowed. The controls flowered in November and produced only one arrow.

The variety B.3013 could not be induced to flower with any of the above treatments.

The above experiments indicate that a copious supply of water throughout the growing period conduces to flowering in sugarcane; that excessive manuring, particularly in the later stages of growth, delays and inhibits flowering, and that by simply adjusting the conditions of manuring and irrigation it is possible to induce flowering and control the times of flowering in the cane varieties desired to be included in the breeding programme at this Station. The author is greatly indebted to Mr. N. L. Dutt, Government Sugarcane Expert, for his keen interest and valuable criticism throughout this investigation.

Imperial Sugarcane Station,
Coimbatore, N. D. YUSUF.
January 1946.

1. Yusuf, N. D., and Dutt, N. L., *Curr. Sci.*, Nov. 1945, **11**, 304-06. 2. Baretto, B. T., *Proc. Asoc. Tec. Azucareros de Cubae*, 1934, **8**, 29–33. 3. Evans, H., *Rept. Sugarcane Research Station (Mauritius)*, 1934, **5**, 40–43. 4. Kerr, H. W., *Cane Growers' Quarterly Bulletin*, Queensland, 1940, **8**, 2, 76.

THE MICRO-ORGANISMS IN *MELOPHAGUS OVINUS*

SMEARS of the intestine of *Melophagus ovinus* show the presence of a Rickettsia. Miss H. Sikora, then working with Prof. Nöller, kindly showed to me how they can be stained with Giemsa's stain. They give a microscopic picture identical with that reproduced by Cowdry.[1] Prof. Nöller, then Director of the Institute of the Institute of Parasitology, Veterinary College, Berlin, kindly demonstrated to me the technique of cultivating the Rickettsia on N.N.N. agar with defibrinated horse blood. The germs grew in about 15 days and gave the same

picture as those of the smears. Noller's Monograph[2] gives details of the technique. The Rickettsia is extracellular in the intestinal lumen of the insect.

Zacharias[3] has published a thesis on the symbiosis of *M. ovinus*. There is a localised region in the intestine where the epithelium contains symbiotic bacteria. Zacharias illustrates the symbiote on p. 692 (Fig. 7); and on p. 701 (Fig. 16). The smears stained with Giemsa show a far larger size of the germs than the Rickettsia and the N.N.N. agar does not serve as a suitable medium for their cultivation. The usual prune juice agar with the addition of liver extract and a trace of ferric chloride enabled the isolation of the symbiote within a week. The germ resembled a Micrococcus species and identical with the illustrations of Zacharias. A loopful of the culture was introduced in defibrinated sheep's blood. It was subsequently found that the white blood cells in this blood were all full with a growth of these Micrococci. It is well known that Gonococcus likewise prefers to multiply in white blood cells rather than in free blood. The explanation in this case has been offered to be the relatively more alkaline pH of the white blood cell which is about 7·2 as compared with that of the body fluids with a pH 6·8. The prune juice agar had a pH 6·8 where the germs did grow while it was also evident that the white blood cells of the sheep proved a better medium for their development. The symbiote of *M. ovinus* did not putrefy sheep's blood nor coagulate it in any way. The isolation was repeated several times and with success.

Zacharias also mentions the occasional presence of another bacterium found intercellularly in the intestinal epithelium of *M. ovinus*. Only once did I get a bacterial culture which gave delicate long rods as illustrated by Zacharias, p. 691 (Fig. 6). For a long time I had doubted his finding but this confirmation gives credit to his observation.

He further mentions the existence of a saprophytic trypanosome in the intestinal fluid of *M. ovinus*, in which I was not interested.

The work was done at Munich, in the laboratory of Prof. Seiler, now at Zürich, to whom I beg to thank once again here.

Biochemical Laboratory,
Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
May 13, 1946.

1. Cowdry, E. V., "Cytological Studies on Heartwater" *11th and 12th Rept. of Director of Veterinary Research*. Union of South Africa, Pretoria; 1927, 196, pl. 1. fig. 2. 2. *Handbuch d. Pathogenen Protozoen* 12 Lieferung. Leipzig, 1928. 3. *Zeit. f. Morpho. u. Ökologie.*, 1928, **10**.

ON THE BIONOMICS OF THE SILVER FISH, *CHELA ARGENTEA*, DAY

Chela untrahi Day. *C. argentea* (Cuv. & Val.), *C. phulo* (Ham. Buch.), *C. boopis* Day., and *C. clupeoides* (Bloch.) are the five species of silver fishes occurring in the inland waters of the Madras Presidency (Day., 1889). They prefer quiet waters and deep pools of rivers, but are active fishes keeping to the surface during day and twilight hours (Sundararaj, 1916). They grow to a size of 6 to 9 inches; and are esteemed as food. They are popular with anglers, as they spring out of the water after the bait (Thomas, 1881).

The food of *Chela argentea*, as revealed by the examination of the stomach-contents of over 500 specimens, consists of (1) algal matter (*Anabæna, Cladophora, Oscillatoria, Pediastrum, Spirulina* and *Spyrogyra*)—10 per cent.; (2) crustaceans (copepods and daphnids)—15 per cent.; (3) diatoms and desmids (*Closterium, Cocconeis, Cosmarium, Cyclotella, Cymbella, Eunotia, Melosira, Navicula, Nitzschia, Pinnularia, Saurirella, Synedra* and *Tabellaria*)—30 per cent.; (4) insect parts—40 per cent.; and (5) sand particles and other inorganic matter—5 per cent. A few fish scales were observed in the stomach of about a dozen specimens.

The fish is a surface feeder, insect life forming the bulk of its diet; and is, therefore, a useful larvicide (Wilson, 1917). Many have stressed the importance of this fish in the control of mosquito incidence (Hora and Mukerji, 1938; Spence and Prater, 1932). Field observations by us have revealed that one specimen of *Chela argentea* feeds on about 100 mosquito larvæ together with other items of its food in a period of twenty-four hours.

The fish breeds in running waters during the monsoons from July to October. During the breeding season, the female has the ventral portion of its body slightly coloured orange or yellow. The ripe ovarian egg is yellowish, round, and 1·20 to 1·50 mm. in diameter. The eggs get swollen immediately after fertilisation, and measures 2·0 to 2·50 mm. in diameter. In about 12 hours, the embryo attains a length of 3·5 mm. and lies curved over the yolk-mass over which light bluish pigments have appeared. Within another eight hours, the embryo hatches out. The larva at this stage is 5 mm. in length, and possesses four gill-slits and a continuous fin-fold. When the larva is four hours old, it measures 8 mm. with well-developed eyes and mouth. The yolk-sac is completely absorbed. Pectoral fin buds become prominent. Scattered bluish pigments appear on the dorsal half of the body. When the larva is 12 mm. in size, the paired and unpaired fins get differentiated. The mouth gets turned upwards. About the alimentary coil, the air bladder appears as a bright capsule. At the size of 15 mm., the fins and operculum are fully developed; and the air-bladder becomes bilobed. At the end of one month after hatching, the fry become 20 mm. in size, and is characterised by a thin laterally compressed body, pellucid cream-white in colour, straight, rostro-dorsal profile, a V-shaped dotted, bluish pattern on the head, and prominent blue eyes.

Inland Fisheries Office, P. I. CHACKO.
Kilpauk, Madras, R. S. VENKATRAMAN.
April 4, 1946. V. RANGANATHAN.

*Published with the kind permission of the Director of Industries and Commerce, Madras.

TAMARIND SEED PECTIN

DAMODARAN AND RANGACHARI[1] have reported that tamarind-seed pectin contains 1·08 per cent. of methoxyl, 33·22 per cent. of araban, 53·11 per cent. of glucosan, 12·59 per cent. of uronic acid and zero value for the calcium pectate number. An examination of these data reveals certain discrepancies regarding the presence of the uronic acid grouping in the molecule. The zero value for the calcium pectate number does not offer support to the existence of the uronic acid nucleus, since the method of Dickson, Otterson and Link (estimation of uronic acid) and the reaction of Carre and Haynes (determination of calcium pectate number) are both dependent on the existence of the same uronic acid grouping. From their data the authors have concluded that the tamarind-seed preparation is a mucilege, since it resembles certain seed mucilages in its chemical composition.[1,2] The examples cited by them do not, however, warrant such a conclusion being drawn. The mucilage from the seeds of *Plantago lanceolata* Linn. yields on hydrolysis 72 per cent. of xylose, 11 per cent. of methyl pentose, 15 per cent. of uronic anhydride and a small amount of galactose,[3] while the mucilage from the seeds of *P. psyllium* Linn. contains 75 to 90 per cent. of xylose and a little arabinose, the rest being galacturonic acid.[4] The composition of the mucilage from the seeds of *P. fastigiata* is similar to that of *P. psyllium*.[5] A comparison of the analytical data of these mucilages with the figures given by Damodaran and Rangachari for the tamarind-seed pectin shows that there is not much in common between them except the reported but unconfirmed[6,7,8] uronic acid content.

The pectic substance from the tamarind seed differs from mucilages in several respects.[9] It is true that, unlike the fruit pectins, it is not a derivative of galacturonic acid. But on account of its characteristic property of forming acid-sugar-jellies, it is to be regarded as a pectin, since the word is now-a-days used as a generic term.[10,11]

Forest Research Institute, Dehra Dun, P. S. RAO. S. KRISHNA.
April 25, 1946.

1. Damodaran and Rangachari, *Curr. Sci.*, 1945, **14**, 203. 2. —, *Ibid.*, 1946, **15**, 20. 3. Mullan and Percival, *J. Chem. So*, 1940, **15**, 1501. 4. Anderson and Fireman, *J. Biol. Chem.*, 1935, **109**, 437. 5. Anderson, Gillette and Sealey, *Ibid.*, 1941, **140**, 569. 6. Ghose and Krishna, *Curr. Sci.*, 1945, **14**, **299**. 7. Nanji, Savur and Sreenivasan, *Ibid.*, 1945, **14**, 129. 8. Savur and Sreenivasan, *Ibid.*, 1946, **15**, 43 9. Ghose, Krishna and Suryaprakasa Rao, *J. Sci. & Ind. Res.* 1946, **4**. 10. Hinton, *Fruit Pectins: Their Chemical Behaviour and Jellying Properties*, printed by His Majesty's Stationery Office, London, **1939**, pp 1, 44 and **92**. 11. Rao and Krishna, *Chemistry & Industry*, 1946, **65**, 101.

TAMARIND SEED "PECTIN"

IN the carefully reasoned Report of the American Chemical Society on Pectin Nomenclature,[1] pectic substances have been worded as "a group designation for those complex carbohydrate derivatives which occur in plants or are prepared from plants and which are characterized by the presence of galacturonic acid units". Other defining characteristics of pectin are the presence of methyl ester groups and the formation, through de-estherification, of pectic acid.[2] It is now recognized that the polysaccharide from tamarind seed differs in all these respects from pectin[3,4] and hence, to class it as one, would be solely on its property of forming sugar-acid jellies.[5] Such a classification, based purely on physical behaviour and not on any constitutional knowledge, would be haphazard and confusing.[6]

The polysaccharide cannot be called a mucilage either;[7] for, recent work has shown that substances commonly described as gums and mucilages, are in fact polyuronides and that their acidic properties are due to the presence of uronic acid whence the name, sometimes given to them, 'acidic polyuronides'.[8]

In an earlier communication,[4] the authors had referred to the polysachharide as a gluco-galacto-xylan and there is little doubt that it is a *polyose* or *hexopentosan*[9] which nomenclature we would, therefore, suggest for adoption in future.

Dept. of Chem. Technology, Bombay University, G. R. SAVUR. A. SREENIVASAN.
May 28, 1946.

1. Committee on Pectin Nomenclature, *Jour. Amer. Chem. Soc. (Proceedings)* 1927, **49**, 37. 2 Nanji, Savur and Sreenivasan, *Curr. Sci*, 1945, **14**, 129. 3. Ghose and Krishna, *Ibid.*, 1945, **14**, 299, 4. Savur and Sreenivasan, *Ibid.*, 1946, **15**, 43. 5. Rao and Krishna, *Chem. and Ind.*, 1946, **9**, 101. 6. Norman, *The Biochemistry of Cellulose, the Polyuronides, Lignin, &c.*, Oxford Univ. Press, 1937, 121. 7. Damodaran and Rangachari, *Curr. Sci.*, 1946, **15**, 20. 8. Norman, same as (6), p. 122. 9. Norman, same as (6), p. 39.

STUDIES ON THE METABOLIC FÆCAL NITROGEN OF CATTLE

ENDOGENOUS urinary nitrogen and metabolic fæcal nitrogen (M.F.N.) values of experimental subjects are essential prerequisites for determining the biological value of proteins according to the Thomas-Mitchell method. Since published experiments on the determination of these data lack scientific precision, a series of investigations was initiated in 1940. The observations on endogenous nitrogen have already been published.[1] The present note gives a short account of studies on M.F.N., details of which will be published elsewhere.

In studying the M.F.N., the first step was to develop a simplified technique, by (1) substituting a low-nitrogen ration for the compara-

tively less palatable nitrogen-free ration, and (2) computing the results by the use of a correction factor. Skim milk protein was found to be unsuitable for incorporation in the low-N diets.

A highly significant quantitative relationship was discovered between the level of fæcal dry-matter output and the M.F.N. of cattle. This relationship is shown in the accompanying graph (Fig. 1). This graph will enable the

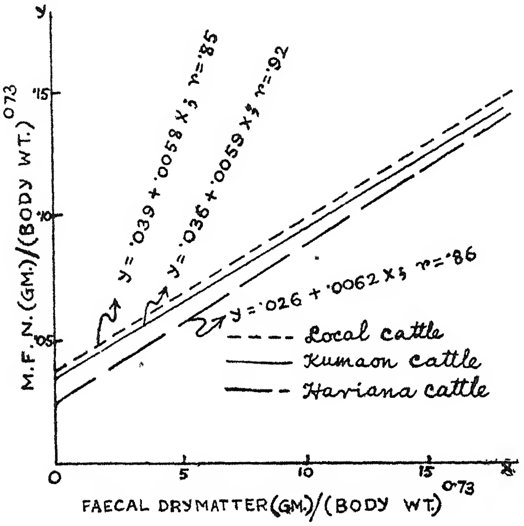


FIG. 1. Relation between daily output of M.F.N. and fæcal dry matter of cattle.

estimation of the M.F.N. of cattle (at least of the three types of cattle studied, namely, Hariana, Kumaon and local non-descript), when the daily excretion of fæcal dry-matter is known.

It has been found that breed characteristics and moisture content of the fresh fæces exert a negligible influence on the value of M.F.N. It was further observed that the M.F.N. of cattle on the same ration decreased with a higher intake of food. The level of fæcal dry-matter output, however, was the predominant factor affecting the M.F.N. of cattle.

Animal Nutrition Section, R. MUKHERJEE.
Imperial Veterinary Research N. D. KEHAR.
Institute, Izatnagar,
April 25, 1946.

1. Kehar, N. D., Mukherjee, R., and Sen, K. C., *Ind. J. Vet. Sci. & Am Husb.*, 1943, **13**, 257.

A CASE OF POLYEMBRYONY IN *DAPHNE CANNABINA* WALL.

DURING an embryological study of a few members of the family Thymalæaceæ, it is found that, usually, a single embryo is developed in each ovule. It develops from the fertilised egg and follows the Asterad type of embryo development. In *Daphne cannabina*, however, a single case has been encountered in which two embryos are developed in an ovule (Fig. 1). One of the two embryos is at a slightly more advanced stage of development. One of them is evidently developed from the fertilised egg and the other seems to have developed from nucellar cells in the apical region of the ovule.

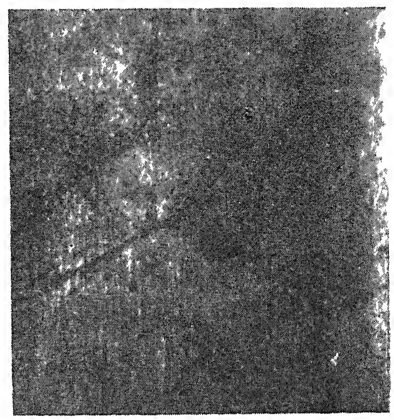


FIG. 1. *Daphne cannabina.* Micro-photograph of L.S. the upper part of the ovule showing two embryos.

Judging from the position of the embryos, the extra embryo could have arisen from a synergid also. But, during the course of the investigation neither egg-like synergids nor additional pollen tubes entering the ovules have been found. Therefore, the origin of the second embryo, from a synergid, seems to be unlikely. Previously, Winkler[1] (1906) recorded a case of nucellar embryony in *Wikstrœmia indica*. In this case, however, the embryo fails to develop from the egg and the single embryo seen is developed from the nucellar cells in the apical region of the ovule.

Andhra University,
Guntur, J. VENKATESWARLU.
March 15, 1946.

1. Winkler, *Ann. Jard. Buitenzorg*, 1906, **2**, 5.

DOES POTASSIUM STIMULATE BY RELEASING ACETYLCHOLINE?

IT has been presumed that potassium stimulates by releasing acetylcholine.[1] The following facts are, however, against this suggestion:—(1) Brown and Feldberg[2] found that curarine, in suitable doses, was found to paralyse the ganglion cell to preganglionic stimulation and to acetylcholine while leaving the cellular response to potassium chloride actually enhanced. Curare has similar action on *mytilus* muscle and frog gastrocnemius.[3] (2) In frog stomach eserine (1 in 10^5) increases the response to acetylcholine but depresses that to potassium.[4] (3) In dog stomach excess of calcium depresses the response to acetylcholine, but increases

that to potassium, the effect of hydrogen ions being also similar.[5,6]

Department of Physiology, Dow Medical College, Karachi, M. C. MUTHANA. INDERJIT SINGH.
May 21, 1946.

1. Ambache, N., *J. Physiol.*, 1946 **104**, 266. 2. Brown, G. L., and Feldberg, W., *Ibid.*, 1936, **86**, 10. 3, 4, 5. Singh, *I.*, *Proc. Ind. Acad. Sci.*, 1946, **23**, 38 ; *J. Physiol.* 1939, **96**, 25; 1940, **98**, 155. 6. Narayana, B., and Singh, *I.*, *Proc. Ind. Acad. Sci.*, 1944, **20**, 192.

A NEW MUTANT IN ASIATIC COTTONS

A NEW mutant was noticed in Asiatic cottons in 1942-43 and its description and inheritance are reported in this note.

The mutant which occurred in a crop of 1027 A.L.F. (*G. herbaceum*), grown in a cultivator's field in the Navasari district of Baroda State, attracted attention mainly due to its monopodial habit and failure to set bolls even at an advanced stage. The buds were abnormal in that the petals and bracts had an indefinite number of whorls with a very compact arrangement and in a majority of cases they shed even without opening. In three flowers which did open later the number of petals was found to range from 7 to 12 instead of the normal 5. To study the behaviour of the mutant (Fig. 1), a normally opened flower was brought to Baroda and crossed with two plants of *G. arboreum*. Both these belonged to the New Multiple Recessive isolated at this Station from a cross of N6 Multiple Recessive with Cocanada 45, one however being heterozygous for the petal colour gene. Only 3 F_1 plants were available from the cross and all the three had normal flowers. The data from F_2 grown in 1944-45 are given below.

In a total population of 143 plants in F_2, 108 plants produced normal flowers while 35 plants gave flowers characteristic of the mutant, which means that the mutant type is a simple recessive to the normal.

Linkage studies were also made side by side as the parents with which the mutant was crossed at Baroda were recessive for a number of characters. The summary of the results is given in Table I.

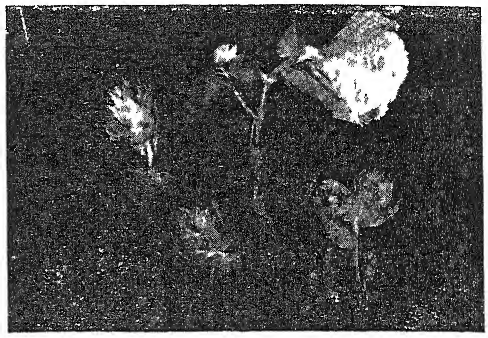


FIG. 1

It can be seen from the table that the segregation obtained in F_2 give a good fit to the 9 : 3 : 3 : 1 dihybrid ratio and that there are no disturbances in the single-factor ratios. The mutant gene is thus not linked and assorts independently of other genes for leaf nectaries, petal colour, pollen colour and anthocyanin pigmentation. Further study of the linkage of the same, if any, with other genes such as for lint colour and leaf-shape is in progress. It was observed in the F_2 that most of the mutant plants besides being monopodial in growth habit had flowers appearing as twins from the same axil unlike the normal plants. The question whether the above is due to a pleiotropic effect of the mutant gene is under investigation. The mutant is characterised by very poor fertility and even with twin flowers any boll that is obtained is only from one of them. The gene pair responsible for the normal and the multi-bracteolata flowers may be tentatively designated as $M^B - m^b$.

TABLE I

Two-factor ratios of crosses of the mutant with the New Multiple Recessive

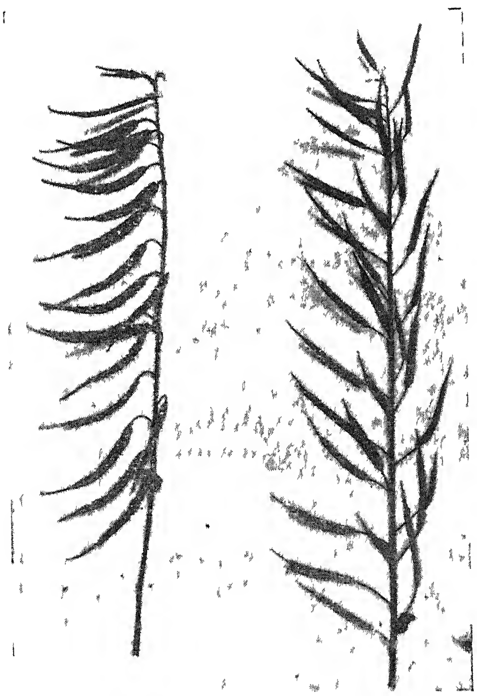
The mutant flower and		Normal flower		Mutant flower		Total	X^2	P
		X	x	X	x			
F_2, *Ne–ne*	obs.	82	26	26	9	143	0·0800	Large
Ya–ya	"	51	15	12	4	82	1·5122	0·70–0·50
Pb–pb	"	89	19	23	6	137	4·6383	0·30–0·20
$R_2AS–R_2OS$	"	89	19	28	7	143	3·6604	0·50–0·30

Baroda, *March* 26, 1946. G. K. GOVANDE, *Economic Botanist*.

A MISSING TYPE OF *BRASSICA CAMPESTRIS* RECOVERED

A CLASSIFICATION of the cultivated Indian mustards has been described by Sabnis and Phatak (1935). They have described thirty-five types of *Brassica campestris* L. One of these types, T 33, belonging to the *Pronisiliquosa* group, was not found among the cultivated types in existence and was described on the basis of herbarium specimens from the Royal Botanical Gardens, Calcutta. It had two-valved, pendant pods (unlike the common cultivated types of *Erectisiliquosa* group which have spreading or ascending pods), and was included in the classification to make it somewhat complete.

This missing type has now been recovered in a collection of new samples of *sarson* (*B. campestris* L.) made in 1941 from the different districts of the United Provinces. This type, named 4114, was discovered in a sample of *sarson* from village Jaitipur, district Unao. It has two-valved, pendant pods, and is constant for these characters. It is shown in the accompanying photograph alongside type 10 which is a normal type with ascending pods.



Type 4114 Type 10

Description of type 4114.—Tall, hairy, late, leaves deep-green and dull, flowers large, petals lemon-yellow, pods long, pendant flat, two-valved, broad and beaded, seed smooth, yellow, bold.

Govt. Research Farm, T S. SABNIS.
Cawnpore, T. R. MEHTA.
April 8, 1946.

1. Sabnis, T. S., and Phatak, M. G., "A preliminary note on the classification of cultivated Indian mustards" *Ind. Jour. Agr. Sci.*, 1935 **5**, 559-78.

SOME NEW HOSTS OF *SCLEROTINIA SCLEROTIORUM* (LIB.) DE BARY

Sclerotinia sclerotiorum (Lib.) de Bary is known to attack many plants. Butler and Bisby (1931) have recorded the host plants of this fungus in India. Mundkur (1934) has given a comprehensive account of the taxonomy and parasitism of this fungus which caused a disease of *Hibiscus sabdariffa* Linn. He was also successful in producing the apothecial stage of the fungus in culture, which the previous workers in India had failed to obtain.

Eruca sativa Mill. is a common *rabi* season crop of the United Provinces, grown chiefly as an oil-seed crop. This year the crop grown at the College farm was very severely attacked and considerably damaged by *Sclerotinia sclerotiorum.* The crop was present as a mixture in an oat field and almost all the plants were badly affected. The disease was noted in the second week of February when the crop was in early stage of fruiting. The disease must have started much earlier as many plants, attacked near the ground-level, had fallen down and were devoid of fruits. The ground was littered with sclerotia and where the attack was particularly severe, there were as many as 78 sclerotia per square foot.

Observations showed that the disease did not start from any particular part of the plant. Patches of dead tissue were scattered throughout the stem, more particularly on the thinner branches. The roots were not affected.

Symptoms.—The affected patches are at first water-soaked in appearance but soon get covered with a weft of white and cottony mycelium. These patches elongate longitudinally and sometimes show distinct concentric zonation. Finally the stem is encircled and numerous sclerotia appear embedded in the mycelium. In the beginning these are white, gradually turning darker and drops of a clear liquid often ooze out from their surface. Internally the sclerotia are often pink coloured at this stage. The sclerotia ultimately become black (Plate I),

PLATE I. Symptoms caused by *Sclerotinia sclerotiorum* on *Brassica juncea*.

and generally fall down on the ground. The sclerotia, however, do not develop plentifully within the stem. The affected pods are similarly covered with superficial mycelium, there being no seed formation but mycelium and sclerotia are often present within the pods. The severely affected parts decompose and shred into fibres, leading to the collapse of the entire plant which falls down and gets covered with copious mycelium and sclerotia. The leaves arising from the infected patches droop down and are shed. The smaller sclerotia are usually round, and the bigger ones are flatter and loaf-shaped or irregular in shape. They measure from 2-12 mm., the average size being 6 mm.

The perfect stage of the fungus.—Although there was an enormous number of freshly fallen sclerotia in the field none of them showed any sign of apothecial development. It was therefore decided to make a thorough search in order to find out whether the sclerotia buried in the soil, from the previous years' crop or those formed earlier in the season, produced any apothecia. In moist patches a number of apothecia in various stages of development were found to arise from sclerotia buried in the soil (Plate II). Their development was carefully studied.

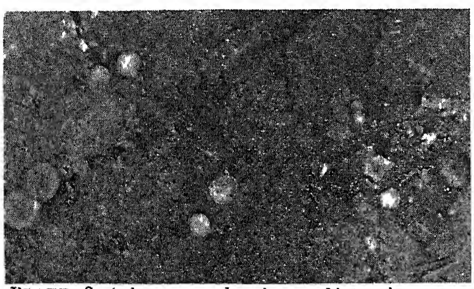


PLATE 2. *Sclerotinia sclerotiorum:* Natural occurrence of apothecia in field.

Usually one or two cylindrical and flexuous stipes are produced from each buried sclerotium, but larger sclerotia sometimes produce as many as five fruiting stipes. The stipes are sometimes dichotomously branched within the soil, each branch being fertile. The length of the stipe varies from 25-88 mm.; the breadth is maximum at the base of the apothecium and is approximately 1 mm. in diameter, but lower down and especially at the point of origin it is much thinner. The exposed part of the stipe is fawn coloured but within the soil the colour is brown or dark-brown. The apothecial fundament is borne at the tip of the stipe as a minute brownish or fawn coloured funnel-shaped structure, just above the surface of the ground. The fundament, usually 1 mm. in diameter, expands into a shallow, flat or convex apothecium. The mature apothecia are 6-9 mm. across, cartridge-buff to pale ochraceous-salmon in colour turning cinnamon brown or Mars brown[1] when old, generally borne 6-10 mm. above the surface of the soil. Sometimes the exposed part of the stipe is branched, usually into two and rarely more than two subsidiary stipes, each bearing a smaller apothecium.

A number of apothecia were teased out and examined under the microscope. The length of the asci varied from 108-153 μ, with an average of 122·9 μ. The breadth from 4·5-8·1 μ, with an average of 5·9 μ. The length of the ascospore varied from 7·2-11·7 μ with an average of 8·9 μ, and the breadth from 3·6-5·4 μ with an average of 3·9 μ. As far as the authors are aware this is the first record in India of the natural occurrence of the apothecial stage of *Sclerotinia.*

Some stray plants of *Brassica juncea* present in the field were found to be affected (Plate I), but the percentage and the extent of damage was far less than in the case of *Eruca sativa.* This was probably due to the more woody nature of the stem of the former plant. The plants of *Eruca sativa* in this particular case were unusually herbaceous due to their being present as a mixture with oats.

A number of plants of *Coriander sativum* Linn. were found wilting in the College Botanical Gardens. There were hardly any symptoms to indicate the presence of *Sclerotinia;* but isolations from affected tissues near the ground-level invariably yielded a fungus culturally similar to *Sclerotinia sclerotiorum.*

As the size of the asci and ascospores differed from those given by Mundkur, the senior author obtained a culture of the fungus from the Imperial Agricultural Research Institute, New Delhi, and on comparison of cultural characters the isolates from *Eruca sativa, Brassica juncea* and *Coriander sativum* appeared similar to the type culture obtained from Delhi. Isolations from the ascospores from fresh apothecia gave identical cultures.

P. R. MEHTA.
BABU SINGH.
S. K. BOSE.

Botanical Section,
Govt. Agricultural College,
Cawnpore,
April 30, 1946.

1. Butler, E. J., and Bisby, G. R., *The Fungi of India*, 1931. 2. Mundkur, B. B., "A *Sclerotinia*-rot of *Hibiscus sabdariffa* Linn." *Ind. Jour. Agri. Sci.*, 1934, 4, 758-78

* Ridgway, R., *Colour Standards and Colour Nomenclature.*

REVIEWS

Vitamins and Hormones, Vol. II. Edited by Robert S. Harris and Kenneth V. Thimann. (Academic Press Inc., New York), 1944. Pp. xv + 514. Price $5.00.

Introducing the series under reference, Prof. McCollum wrote: "The time is ripe for the founding of such a venture since it is no longer possible for any one to read sufficient of the current papers and library files dealing with these two classes of substances to assimilate all the knowledge which has accumulated. We must increasingly depend upon our colleagues, who maintain mastery of specialised experimentation to appraise for us the numerous contributions which they alone can interpret, sifting error from truth and assembling scattered data to make a connected account which places a body of related facts in proper perspective. This is the function of the new publication."

The second volume of the series under review fulfils the function as envisaged by Professor McCollum; the volume includes a wide range of topics covering the physical, chemical, physiological and clinical aspects of some of the important vitamins and hormones. Eleven topics have been discussed in the present volume: (1) Vitamins in the anabolism of fats; (2) Chemistry of biotin; (3) Nutritional requirements of primates other than man; (4) Physiological action of vitamin E and its analogues; (5) Chemistry and physiology of vitamin A; (6) Para-amino benzoic acid—Experimental and clincal studies; (7) A critique of the etiology of dental caries; (8) Vitamins and cancer; (9) Effect of Androgens and Estrogens on birds; (10) Hormones in cancer; and (11) X-ray crystallography and steroid structure.

Of special interest to those interested in problems of cancer, one of the deadliest curses on humanity, are the two chapters on cancer in relation to vitamins and hormones. One of them (Vitamins and Cancer) constitutes an inspiring presentation of the intricate problem, which is full of attractive suggestions for future investigators.

A perusal of topics listed above show the wide and varied appeal and interest which they are bound to elicit. The series, of which the present volume forms a part will be enthusiastically welcomed by all investigators interested in the pure and applied aspects of vitamins and hormones. The publishers deserve to be congratulated on their enterprise in filling so admirably the void created by the disappearance of "Ergebnisse der Vitamin und Hormon-Forschung".

Radar. By Major R. W. Hallows. (Chapman and Hall, London, W.C. 2), 1946. Pp. 140. 7*sh*. 6*d*. net.

In 1925 Breit and Tuve of Carnegie Institution of Washington successfully used the pulse method for determining the height of the ionosphere and since then, every worker in the field of radio communication in every part of the world was aware of the Radar as a possibility of the near future. The threat of war intensified the work in this direction during the thirties in all countries. The credit of developing a practical and rugged form of it for the first time goes to Sir Edward Appleton and Sir Robert Watson-Watt, two brilliant products of the Cavendish Laboratory. And now, the credit for writing the most popular and lucid account of the Radar goes to yet another Cambridge man, the author of the book under review!

The first official release on the Radar was a report by the Joint Board of Information Policy of the Scientific Research and Development, War and Navy Departments of the U.S.A., in August 1945. This has been followed by articles and reports in technical and non-technical journals which are not of great use to the man-in-the-street. The book under review supplies this great want.

Any man or woman with an average amount of commonsense and intelligence can read through the book like a novel. It is the outcome of the author's experience as a chief instructor in the Fire Control (Radar), 6th anti-aircraft group school in Britain. In the foreword to the book, General Sir F. A. Pile, Commander-in-Chief of the A. A. Command, 1939-46, rightly observes that "the author has the gift of making extremely difficult and obtruse things appear simple and even obvious". The function of the Radar, the principle of reflection, the speed of light, the idea of small intervals of time like micro-seconds, an electron beam as an inertialess relay, the cathode-ray oscillograph, etc., are all most lucidly and elegantly explained in successive chapters and this is followed by actual descriptions of the Radar. A welcome feature of the book are the beautiful Crown copyright photographs of the British Radars, etc.

The printing and get-up of the book are excellent and there are numerous good figures drawn to explain the principles enunciated in the body of the text.

Radar is one of the greatest inventions of the war and its possible uses in peace are immense. No man, woman or child can afford to be ignorant of its basic principles, and here is a book most eminently suited for the purpose. It needs no recommendation. The reviewer is certain that every school, college, private and public library shall go in for a copy of the book. The book has its utility to the technical man also. It provides a most beautiful introduction.

S. V. Chandrasekhar Aiya.

The Cavendish Laboratory. By Alexander Wood. (Cambridge University Press), 1946. Pp. 60. 8 Plates. Price 2/6.

The establishment of the Cavendish Laboratory in Cambridge in 1874 may truly be said to have marked the beginning of the most glorious chapter in the progress of scientific

research in Great Britain—ushering in the era of modern physics. In the domain of physics, the Cavendish Laboratory has been intimately associated with the most notable personalities and almost all the epoch-making discoveries. Therefore the stupendity of the task involved in condensing the entire history of the Cavendish Laboratory into few pages of a booklet may be well understood. Dr. Wood has achieved this to a commendable extent in this booklet of 60 pages. A survey of the most important events and anecdotes connected with the Cavendish Laboratory starting from the quiet beginnings under the professorship of Clerk Maxwell in 1875, followed by Lord Rayleigh and then by "the man who split the atom", namely, J. J. Thomson, has been made in the first forty pages. The remaining twenty pages are devoted to a brief summary of the most important events that took place under the leadership of Lord Rutherford, "the alchemist", and his successor, Sir Lawrence Bragg. The book presents an interesting and instructive pen-picture of the world-famous laboratory.

R. S. K.

India—Part I. Physical Basis of Geography of India. By H. L. Chhibber. (Nand Kishore & Bros., Benares), 1945. Pp. xix + 282, with 10 plates and 19 text-figures and maps. Price Rs. 5.

Books on the physical geography of India are rare and, therefore, the publication of this work by Dr. Chhibber is to be welcomed. The book is divided into twenty chapters and deals with the physical divisions of India, mountains, plateaus, rivers, lakes, glaciers, earthquakes, coast lines, volcanoes, hot springs and mineral waters, climate and climatic regions of India, weathering and denudation, geology, soils and soil erosion, fertilisers and manures, and the structure of India. An alphabetical index at the end adds to the value of the book.

There is some confusion as regards the title of the book. On the back of the cover the book is entitled "Physical Basis of Geography of India—Part I", whereas on the first page of the cover as well as inside it is printed as "India—Part I. Physical Basis of Geography of India". The two do not mean the same.

On page 173, the Dharwars are stated to occur in narrow elongated synclines *resting* on the gneiss. Again on page 189, the Dharwar rocks are supposed to have been derived from the denudation of the Archæan gneisses. This is not correct as the Dharwars in most of the areas in India are now considered as the oldest rock formations into which the later gneisses have intruded, except perhaps in Rajputana where the gneisses are regarded as older than the Aravallis.

Mer de glace is only one of the Alpine glaciers and not a collective name for the glaciers of the Alps as suggested on page 79. The name is misspelt both in the text and in the index.

This book is unfortunately marred by numerous printing errors. The first person to use the term "Laterite" was not Buchman as stated on page 210 but Buchanan. "Quaternary' has been consistently misspelt, twice on page 170, and again in the index.

Geologists and geographers will find in this book a useful collection of material on the physical geography of India.

C. S. P.

Annual Review of Biochemical and Allied Research in India, Vol. XIV. (Society of Biological Chemists, India, Bangalore), 1943. Pp. 142. Price Rs. 3 or 6 *sh.*

The *Annual Review* was published in 1945 with a note of apology for the inordinate delay caused by 'unforeseen circumstances'. Except for the delay, these 'circumstances' seem to have had no adverse effect on either the contents or the general make-up of the *Review* itself. The investigations in the field of Biochemistry and related branches of science, reported during the year, have been reviewed in an exhaustive manner under twelve chapters. A regrettable feature, however, noticed in the chapter on Industrial Mycology, is the replication of the previous years' reviews, though presented in a slightly different guise. If found absolutely necessary, a mere reference to the previous years' reviews would have been sufficient. Instead, one finds the same work described at length once again. A repetition of this sort is apt to frustrate the very purpose of an 'annual' review and, therefore, needs to be eliminated. An index of the periodicals from which matter is collected for the *Review* would be a vaulable addition to the existing regular features.

S. R. Aswatha Narayana Rao.

WAR-TIME ADVANCES IN PHYSIOLOGY

Annual Review of Physiology, Vol. VII. By James M. Luck and Victor E. Hall. (American Physiology Society and Annual Reviews Inc., Stanford University, P.O. California.) Pp. vii + 774. Price $5.00.

THE seventh volume of these *Annual Reviews* which have practically grown during the war years, is the largest yet published; the volume has been published on the eve of the approaching end of the world conflict. During the preceding difficult and anxious years, scientists have had to regiment themselves in the cause of applied research of vital importance to the prosecution of war. The belligerent governments during the war, extended their unstinted and lavish financial support to schemes of research, to a degree which has been unprecedented in the history of research; the operations of war, bloodier and more inhuman as they proved to be, have been responsible for raising many an urgent problem in human physiology, which would have been hardly thought of. Unprecedented opportunities and uncommon materials of research became abundantly available during the war. Physiological research was most intensively

perused, more particularly in its applied aspects. Much of this work which had to be maintained as a closely guarded secret on grounds of security, is expected to be reviewed in these *Annual Reviews* during the coming post-war years.

Researches in the domain of physiology as reflected in the volume under review are naturally dominated by a strong bias towards the critical exigencies of war. The combating personnel associated with the three services—land, sea and air,—had to be subjected during their fighting operations, to extreme degrees of stress and strain, which had never been attained during any of the previous wars. The maintenance of the highest degree of occupational fitness among men and women on every front was essential for winning the war. The human organism experienced new heights of endurance and achievement; these experiences are contributions to physiology which would never have been made but for the war.

The *Review* follows the general plan of its predecessors; it contains twenty-six contributions. The advances in the fundamental aspects of physiology, *e.g.*, permeability, physical properties of protoplasm, physiological aspects of radiant energy, physiological aspects of genetics, development physiology, are each reviewed in the chapter bearing the title. Water metabolism attained special significance, thanks to "the necessities of war waged on a global scale" and the literature pertaining to this problem which has developed to an unusual degree, has been reviewed. The disturbance in fluid balance, incidental to extensive burns, severe hæmorrhages, traumatic shocks, water and salt deprivations and exposure to extremes of environment, have received special attention. The physiological effects of heat and cold form the topic of an interesting review; much of the stimulus for investigation of the human response to cold has been provided by the pressing need "for data on the physiological changes resulting from prolonged exposure such as occurs in life-boats in northern oceans, men fighting in semi-arctic terrain and aviators who have made forced landings in the snow". Among other chapters of general interest are those entitled, Exercise, Physiological Psychology and Applied Physiology. The volume is well documented with author and subject indices and contains 4,348 references to literature. These *Annual Reviews*, in the coming years, will undoubtedly acquire an even greater degree of usefulness to all interested in the pure and applied aspects of physiology.

SCIENCE NOTES AND NEWS

Chromosomes in *Butomopsis lanceolata*.—Mr. Y. Sundar Rao (Mrs. A. V. N. College, Vizagapatam) records the chromosome number in *Butomopsis lanceolata* Kunth., a member of Butomaceæ. The haploid number is 7 and the bivalents from variable number of chiasmata, the number being proportional to the length of chromosomes. There are two long pairs and others vary in length. A study of meiosis and mitosis will be published elsewhere.

Deputation of Eminent Indian Scientists.—Following the successful tour of the Indian Scientists to the U.K. and the U.S.A. in the latter half of 1944, it was decided that batches of eminent Indian scientists who were studying important problems either directly concerned with matters of national importance or connected with such matters should go abroad, not on a peripatetic tour but for special study in their respective subjects over a period of about six months. It was felt that such visits would enable the scientists to acquire valuable experience in modern development which would greatly benefit the country on their return. It was also felt that once such contacts had been made, it would become much easier for Indian scientists to go abroad with the assurance that they would meet leading men of science and, under their guidance, be put in touch with the appropriate research institutions.

Under this scheme it is proposed to send the following scientists to the U.K. and U.S.A. in the first batch :—

(1) Dr. M. R. Siddiqi, M.A., Ph.D., D.Sc., F.N.I., Director of the Research Institute, Osmania University, Hyderabad.
(2) Dr. K. S. Krishnan, D.Sc., F.R.S., Professor of Physics, Allahabad University.
(3) Dr. H. J. Bhabha, F.R.S., Director, Tata Institute of Fundamental Research, Bombay.
(4) Dr. K. N. Bahl, Professor of Zoology, Lucknow University.

Dr. Siddiqi and Dr. Krishnan have already left for the U.K. More recently, Dr. Bhabha has reached England. These three scientists are also among the Indian delegates to the Royal Society's Empire Scientific Conference which commenced its session in London on the 17th June 1946.

SARDAR BAHADUR SIR DATAR SINGH.—Datar Singh, Sardar Bahadur, Sir, Fellow of the Royal Society of Art, London, Cattle Utilisation Adviser to the Government of India. Sardar Bahadur 1937; Kt. Cr. 1939; Member, Imperial Council of Agricultural Research of India since 1933. After completing his studies in India, he went to England in 1919 and returned to India in 1921 after specializing in Dairying and started an up-to-date Dairy Farm in India; represented India at the International Dairy Conference, Copenhagen, in 1931 and Berlin 1937. Examiner of the All-India Dairy Diploma since 1935; Non-Official

Adviser to the Government of India for the Trade Negotiations between H.M. Government in U.K. and Government of India and was sent to England in 1937 on this duty; served as Non-Official Adviser to Government of India in Indo-Japanese Trade Negotiations; has been a Member of the Central Board of Interview of Emergency Commissions in India; Member of the Central Food Advisory Council; Member of the General Policy Committee; Member of the Export Advisory Council; led Indian Industrial Delegation to Australia and New Zealand, 1945. Has taken keen interest in Animal Husbandry problems of India.

Since taking over charge as Cattle Utilisation Adviser in August 1944, he has been organising the *Gowshalas* and Pinjrapoles in India to work on improved lines, so that instead of their being asylum for old and infirm animals, they should also increase the milk production and improve the cattle breeding. For this, his schemes have been sanctioned in most of the provinces. He has been helping in the organisation of salvage of dry cattle and also in the enforcement of the restrictions on the slaughter of useful cattle in the provinces.

SIR HERBERT STEWART, C.I.E., I.A.S., Vice-Chairman of the Imperial Council of Agricultural Research, and President of the Indian Central Jute Committee, having gone on four months' leave, Sardar Bahadur Sir Datar Singh, Joint Vice-Chairman, Imperial Council of Agricultural Research, has taken over charge recently as President of the Indian Central Jute Committee and Vice-Chairman of the Imperial Council of Agricultural Research.

RAI BAHADUR G. C. SEN, Deputy Secretary to the Government of India, Department of Agriculture, has been appointed Secretary of the Indian Central Jute Committee. He took over charge on the 3rd June from Mr. C. R. Nodder, the acting Secretary, who has reverted to his substantive post of Director of the Technological Research Laboratories of the Committee at Tollygunge from the same day.

It is understood that MR. K. RAMIAH, Director-designate of the Rice Research Station, who was entrusted with the task of selecting a suitable site for the location of the Station, has recommended Bidhyadharpur, Orissa, for serious consideration.

Central State Scholarships.—The practice of the Government of India of awarding one Central State Scholarship annually for study in Great Britain, which had to be discontinued during the period of the war, has now been revived. No awards were made during the last four years. For the year 1946-47, three scholarships have been awarded to the following candidates:—(1) Miss Musarrat Jahan Begum Temuri of Delhi, (2) Mr. Raghu Raj Bahadur of Delhi and (3) Mr. Girdhari Lal Gupta of Ajmer-Merwara.

The Joykissen Mookerjee Gold Medal for 1944, and the H. K. Sen Memorial Medal for 1946, have both been awarded to Sir Shanti Swarup Bhatnagar. The former is awarded annually by the Indian Association for the Cultivation of Science, for an eminent scientist whose association with the Institution is considered by the management to be in the best interests of scientific progress in India. The H. K. Sen Memorial Medal is awarded annually by the Institution of Chemists (India) to an eminent industrial chemist selected by the Council of the Institution.

SIR SHANTI SWARUP BHATNAGAR, O.B.E., D.Sc., F.R.S., has been elected a Fellow of the University College, London.

The Central Bureau of Education, Education Department, Government of India, is collecting information about educational, scientific and cultural organisations, as well as learned and research bodies in India. All such organisations are requested to supply up-to-date information about their constitution and activities to the Curator, Central Bureau of Education, Education Department, Government of India, New Delhi, by June 25.

Lady Tata Memorial Trust: *Scholarships and Grants for the year* 1946-47.—The Trustees of the Lady Tata Memorial Trust have just announced, on 18th June 1946, the death anniversary of Lady Tata awards of scholarships and grants for the year 1946-47.

The International awards for research in diseases of the blood with special reference to Leucæmias are made to Doctors Jorgen Bichel (Denmark), Pierre Cazal (France), Jal J. Dubash (India), Pierre Dustin (Belgium), Peter A. Gorer (South Africa), Maurice Guerin (France), Simon Iversen (Denmark), Werner Jacobson (England), Joseph Japa (Poland), Edith Paterson (England), Hall Schartum-Hansen (Norway) and Prof. Edoardo Storti (Italy).

Indian scholarships of Rs. 150 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering are awarded to Messrs. L. D. Sanghvi (Bombay), T. A. Venkitasubramania (Ernakulam), G. Balasubramanyam (Bangalore), T. K. Wadhwani (Bangalore), Rabindra Kumar Basu (Calcutta), S. Swaminathan (Bangalore), Jagannath Ganguly (Bangalore), Bhagchandra Jain (Bangalore) and Miss Anne Kumari Paul (Bombay).

ERRATA

Vol. 15, No. 4, April 1946

Page 99, column 1, para 2, line 3 from bottom: *for* "a portion of 3 to 89", *read* "a proportion of 3 to 97."

Page 115, column 1, lines 15 and 16 from bottom: *After* "The Decimal and Colon Classifications (A Summary and a Comparison)", *insert* "By R. S. Parkhi."

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THE ETERNAL GLORY OF AYURVEDA

IN the inscrutable Providence of political conflicts among nations and the resulting domination of one civilisation over another the cultural heritage of the fallen nation very often fails to get due recognition and support from the new Government and its agents and in consequence becomes decadent by sheer discouragement and neglect. This has been the fate of the Ayurvedic system of medicine during the last over one century. The further establishment of Western medicine as the official system enjoying the sole monopoly of State patronage till very recently has made matters more difficult for the practitioners of the indigenous systems of medicine. This circumstance has driven the best brains of the nation from cultivating their cultural heritage.

During the last fifty years, however, patriotic attempts have been made by interested individuals as well as public bodies to get fairplay and due recognition for the National healing art which was performing its duty successfully before its replacement without adequate reason and enquiry by the more costly Western system. The writer has been taking a purely scientific and especially chemical interest in this subject and has profited by taking part in the Fourteenth All-India Ayurvedic Conference, Colombo, 1924; in the Second Karnataka Ayurvedic Conference, Bangalore, 1926; and in the Twenty-first All-India Ayurvedic Conference, Mysore, 1930; in addition to professional discussions with Ayurvedic practitioners, and reviews of reports published by the various committees of enquiry appointed from time to time into the indigenous systems of medicine and their drugs.

In view of the recent rather acrimonious controversy in the Madras Daily Press, over a recent alleged public announcement by the Honourable Minister for Public Health of her intention to encourage the indigenous systems of medicines, the writer welcomed an opportunity to place his own scientific impressions on this subject for the patriotic consideration of his fellow-workers in modern scientific pursuits.

It should be remarked at the outset that it is to the lasting credit of the votaries of the ancient Indian system of medicine that they called their professional art by the name of Ayurveda (*Ayur* = life, *veda* = scientific knowledge), that is, the science of life and of healthy longevity. Medicine in their eyes was not a catalogue of makeshift devices to get over disease and re-establish bodily ease, but it was the synthetic embodiment of all the scientific facts underlying and regulating the life of man in its varied physical, physiological and psychical aspects and stages, in a word, the science of life as a whole.

To the critical student, the *Vedas*, which form the holiest of Hindu scriptures, are known to be important treatises on medicine and surgery, the *Rigveda* dealing mainly with the former and the *Yajurveda* and *Atharvaveda* with the latter. These three *Vedas* are the principal sources of Ayurveda. With these as foundations, fundamental treatises of Ayurveda have been written by Charaka, Susruta and Vagbhata. Among the important branches of Ayurveda treated in these works are, (1) the science of pulse examination, (2) the science of bacteriology and (3) the science of vivisection.

The science of pulse examination formed the basis of the doctrine of *Tridhatu* or *Tridosha*, popularly known as the *vata*, *pitha* and *kapha*,

These are supposed to represent the respiratory, circulatory and nervous mechanisms of the human system and the maintenance of bodily health is believed to depend upon a perfect equilibrium and interdependence of these three essential functions.

The Ayurvedic writings of Bodhayana, Kausika and others are full of references to different kinds of bacteria relating to different diseases.[1]

Regarding vivisection, it is interesting to know that the sacrificial texts of *Yajurveda*, especially the *Adhana panchaka* of the *Srowta bhaga*, deals with nothing but vivisection not of some sporadic instance of the animal world but of a systematic and graded study ranging from birds and reptiles upto man himself who is the crown and completion of all living creation with clear references to as many as forty different species of the animal kingdom.[2] In such studies the subjects to which importance was attached were of three kinds:—(*a*) the functioning of individual visceral organs, (*b*) the five main physiological systems of alimentary-circulatory, respiratory, cerebro-spinal, autonomic, and the genito-urinary, called respectively in Samskrit as *annamaya*, *pranamaya*, *manomaya*, *vignanamaya* and *anandamaya kosas*, and (*c*) the phenomenon of sex metamorphosis which is still a mystery to modern scientists; besides various other interesting studies relating to the therapeutic action of certain drugs on animal bodies. These are fully explained in the *Soma panchaka* of *Srowta bhaga*.[3]

As the Calcutta University commissioners truly observe in their Report (Vol. V, p. 58), "the ancient system of Indian medicine possessed an imposing treasure of empirical knowledge and technical achievement which cannot be safely ignored even in these days of rapid progress". The chief difficulty, however, lies in the fact that all this learning is written in Samskrit without a knowledge of which it is difficult to get at the originals. Owing to long neglect the art has decayed along with the practitioners but in the interests of knowledge it should be resuscitated and made efficient in practice by taking the fullest aid of modern scientific knowledge and vitality.

As *Rajamantrapravina* P. G. de Souza put it before the Mysore Ayurvedic Conference,[4] "it is imperative that every university should open a department of Indian Medicine not only to qualify persons wishing to do so but to carry on research in order to make the Indian system of medicine fully self-sufficient and efficient. It is rather strange that a proposal to establish a chair of Indian Medicine is often met with a chorus of opposition on the plea that such activities are not consistent with modern traditions though people have no objection to create chairs in fanciful subjects like archæology or palæontology. The training of Ayurvedic practitioners should include a study of the general principles of all sciences connected with medicine. The science of Ayurveda itself should be subjected to constant examination in the light of modern scientific methods and a spirit of growth and vitality infused into it."

So much for the essential value and necessity for the restoration and development of Ayurveda on its original foundations. In this respect as the President of the same Ayurvedic Conference remarked,[5] "it should be borne in mind that the official system of Western medicine is constantly trying to evolve better methods of diagnosis and sounder methods of treatment and forge new weapons of precision to combat diseases. In fact for this purpose they have absorbed in their practice many medicinal agents from the Ayurvedic materia medica, *e.g.*, *Kutaja* (Kurchi) and several others. In fact, when Ayurveda was official and flourishing in this country the great living maxim of Charaka was well kept in mind by every physician :

तदेव युक्तं भैषज्यं यदारोग्याय कल्पते ॥

(Whatever is conducive to the cure of diseases is the proper remedy.)

Looking at the matter from a chemical point of view one is struck by the large number and variety of natural products employed successfully as curative materials by the Ayurvedic practitioners as a result of the immensity of valuable therapeutic knowledge of these accumulated by centuries of observation. It has been the practice among advocates of indigenous drugs for use in the Western system of medicine, to extract some of these drugs for what are known as active principles with a view to employ the latter for the same purposes as the crude drug. This practice, which had currency for some time, soon proved dangerous as it was frequently found that the extracted principles very often had not even a fraction of the efficacy of the crude drug. As has been shown recently by Miss Irani in the case of Kurchi seeds the constituents of a crude drug responsible for its curative action may be in a different and much more complex stage of combination than the substances usually isolated from them in the form of the so-called active principles.[6]

The question therefore of substitution of Ayurvedic drugs by their so-called active principles may be fraught with dangerous consequences and hence researches on indigenous drugs should be undertaken with simultaneous proper arrangements for systematic clinical trials of extracts or principles prepared from them.

Besides the chemical aspect of indigenous drugs the botanical and horticultural aspects require to be attended to also. Without going into fuller details of other aspects of the matter one may conclude that it is the imperative duty of the Indian Government as well as of the practitioners of Ayurvedic medicine to develop its usefulness and hidden wisdom with the aid of all modern scientific knowledge. This is best done by the establishment of Ayurvedic Colleges wherein full facilities for the cultivation of medicinal plants, their proper characterisation and their investigation by organic and biochemical methods and their application in medicine by clinical trials will be provided. The main responsibility is on the practitioners of the profession and on scientists in general who should organise the necessary professional associations and laboratories and seek governmental assistance on the financial side. In that way only lies the surest road to establish the fundamental glory of Ayurvedic Medicine not only in India but in the whole world as the soundest and yet the

most inexpensive system of medication ever propounded.

All the above arguments regarding Ayurveda apply with equal force to the Siddha and Unani systems of Indian medicine which are based on Ayurveda as pointed out by the late renowned Janab Hakim Ajmal Khan Bahadur in the scheme of the Ayurvedic and Unani Tibbi College established at Delhi as an immortal tribute to his professional patriotism.

P. RAMASWAMI AYYAR.

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1. *Report of the Twenty-first All India Ayurvedic Conference, Mysore*, 1930, p. 75. 2. *Ibid.*, p. 80. 3 *Ibid.*, p. 81. 4. *Ibid.*, p 25. 5. *Ibid.*, p. 39. 6. *Curr. Sci.*, 1946, **15**, 106

EMPIRE SCIENTIFIC CONFERENCE

ON the occasion of the Opening Ceremony of the Royal Society Empire Scientific Conference held in London on June 17, His Majesty the King declared:—

It gives me great pleasure to be here to-day to open the Empire Scientific Conference, and to greet the delegates. It is the first Conference of its kind but I hope it is destined to be the beginning of an era of closer contact in scientific affairs within the Empire. Nothing can take the place of personal contacts. However clearly a man may write, the spoken word has a directness of appeal which cannot be achieved in any other medium.

I am, therefore, very glad to know that you will discuss whether there should be more such meetings as this Conference and this is a question which, I do not doubt, you will answer in the affirmative. Furthermore, I hope that you will arrange meetings of a more specialised character; and that, whether the meetings be general or related to specific activities, they should not always be held in London but periodically in one or other of the capital cities of the Empire.

We have recently emerged from a terrible war in which, with God's help, we and our Allies were victorious. For six years, the means of waging war and securing peace have filled our minds and occupied our days. Our energies were concentrated for the most part upon destroying the power of our enemies. Not only had old weapons to be continually improved; but new ones had to be devised, and in this work the scientists played an essential part. But not all the work of scientists had destructive ends in view. Great advances have been made which are of the highest importance to civilisation in times of peace. They cover a vast range and I will mention only one or two of the more important.

In Penicillin we have a powerful means of fighting disease, the potentialities of which have certainly not yet been fully explored. New insecticides enable us to control and perhaps to defeat the malarial mosquito.

We have increased our knowledge of the effects of shock on the nervous system and of the reactions of the human body to rapid changes of temperature and pressure. We have made great strides in the discovery and production of organic chemicals and synthetic drugs.

Our necessities have led us to make substantial advances in agriculture and veterinary science. We are also better able to forecast the weather, a development which has been, and must increasingly be, based upon international co-operation. It is, of course, of great importance to the growth of civil aviation. So, too, with Radar, which has developed for our protection from attack by hostile aircraft, will contribute greatly to the safety of navigation by air and sea. New methods of wireless communication have been evolved, and electronic methods have been adapted to the timing of events which occur so rapidly as to be beyond the scope of any purely mechanical system. Jet-propulsion has opened up the possibility of flight at speeds greater than that of sound.

Finally, the production of the atomic bomb through scientific prediction and scientific collaboration has brought home to the world with terrifying directness the fact that the increase in man's knowledge of the material universe may be fraught with infinite possibilities of good and evil. This must never be used as an argument against scientific research. It should rather lead us all to seek for ways and means of increasing our respect for moral principles and to endeavour under God's guidance to reject the evil and choose only the good.

There is good reason to believe that the nearness of the war to the civilian population in their homes and in their daily lives, has brought about an awareness of the power of the scientific method and a realisation that what has helped to win the war will also be of service in making the world healthier, happier and more prosperous. We now have to make good the wastage of the last six years and restore our shattered economy, and scientific research must play a great part in reconstruction. It is, therefore, very gratifying to me to note that my Governments in the United Kingdom and in the Dominions and India have all made provision for increased expenditure upon scientific education and research, in spite of many other calls which they will have to meet. We must see to it that the available resources, both in money and manpower, are efficiently applied.

The Empire is a laboratory richly stored with materials and it covers a very wide range of terrestrial and climatic conditions. By co-operation in the Commonwealth we can, therefore, develop a greater and wider field of scientific investigation than any other community, always excepting the United Nations Organization, with which we intend to work to the full. The nations of the British Commonwealth will, I am sure, be ready to play their part.

I now declare the Empire Scientific Conference open and I pray that God may prosper your deliberations.

NUTRITIONAL IMPROVEMENT OF RICE

By A. SREENIVASAN

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THE nutritive value of rice, as of all cereals, lies primarily in its high fuel value. Where, however, it constitutes a high proportion of the total diet, as in India and the East in general, consideration must be given to its content of the major nutrients such as proteins, minerals and vitamins. In assessing the nutritional qualities of rice, the feature of outstanding importance is the high concentration of essential ingredients found both in the outer coat and in the germ or embryo. The outer envelope or bran and the germ together constitute nearly one-sixth of the whole grain, the remainder being the endosperm or polished rice. Between them they contain more than half the mineral matter of the whole grain, a fourth of the proteins and practically all the fats and vitamins; they are also the fractions which are completely removed in the process of polishing.

In spite of this recognized loss in food value which rice suffers on polishing,[1-3] there is a general and widespread preference for polished rice. The reason is not far to seek when it is remembered that rice, unlike all other cereals, is predominantly consumed as cooked, whole grains and not as meal or flour. Trade demands and consumer preferences have, therefore, been determined mainly by external and physical characteristics. Polished rice has a pleasing appearance and texture, it cooks more easily and is digested better[4] than the unpolished grain and, in the raw condition, it keeps far better and can be stored for long periods or transported over long distances without appreciable deterioration. This last quality is the one which appeals to the largest section of both producers and consumers. It is also the chief reason which has militated against the introduction of any major legislation to check the wholesale replacement of unlimited rice by the milled product.

MODE OF PREPARATION OF RICE

In addition to the loss in nutritive value which rice suffers on polishing, the wasteful effects of repeated washing before cooking and of cooking in excess of water involving drainage of gruel, both of them again unique operations in the preparation of rice for food, are familiar knowledge.[5-9] Happily, some improvement has taken place in regard to the mode of cooking for, in most well regulated households, only enough water is used as would enable the rice to swell to its proper consistency. Washing losses, which are even more serious than the effects of cooking in excess water,[1] can and should be eliminated if polishing powders such as talc, chalk and glucose are avoided; their use is not being encountered in recent literature except, in a limited way, in Spain, Italy and the United States. Improvements in the cleanliness of mills and storage places are, however, essential since washing is unnecessary in case of clean, milled rice of good commercial quality, the milling in itself being a cleaning process.

SELECTION OF RICE VARIETIES

Yet another factor to be reckoned in evaluating nutritive quality in rice relates to the general favour evinced by consumers for the fine-grained, long and white varieties of rice which are often poorer in essential nutritional elements as compared to the coarse-grained and coloured varieties of rice.[10, 11] The latter also have thicker aleurone layers.[12] Improvements in rice culture have hitherto been aimed at increasing yield and other hereditary qualities such as grain size, appearance, milling and cooking properties but it should be possible to lay sufficient stress on the nutritive value of the grain as well and to encourage the grower to raise nutritionally rich varieties. As with wheat and barley,[13] manuring is another potent method of improving both the total yield and the proportion of nutritive constituents in rice.[10]

UNMILLED RICE

Any improvement in rice quality aimed or achieved through selection of right varieties or reform in mode of preparation for food can only be of minor significance compared to what may be possible through advocacy in the use of whole, unpolished rice. Repeated efforts have, therefore, been made by nutritionists and health propagandists to combat this serious shortcoming in the use of rice as a food grain. It has been suggested that the poor keeping quality of unmilled rice can be overcome by shelling the required quantity from time to time in small wooden hand-hullers or in hand or power-driven hullers which are also available. The practice of preparing rice for consumption by hand-hulling or home pounding has, however, rapidly given place to the custom of using machine-milled rice even in rural areas. The reasons for the abandonment of home pounding are many: small rice mills have been on the increase as cheap electricity became available; better roads and transportation facilities have enabled the paddy-grower to bring his paddy to a mill, thereby sparing the village folk this hard labour. Even small rice-growers are used to sell their paddy and buy machine-milled rice. Thus, home-pounded rice has become more expensive and does not meet the competition of the cheaper highly milled product.[7]

UNDERMILLING OF RICE

It has been argued that, while it may not be quite a practical proposition to ask people to go back to hand-pounded rice, even a lower degree of milling would do a great deal of good. Thus, in 1937, the League of Nations' Inter-Governmental Conference of Far Eastern Countries on Rural Hygiene met in Java and recommended the use of undermilled rice in Government institutions and its popularisation elsewhere by education and propaganda. Attention was called to the desirability of checking the spread of mechanical rice mills in rural areas and promoting the availability of undermilled rice to consumers. No new equipment

is needed for its production; it can be obtained simply by less drastic scouring in the mill, either by loosening the huller blades or by avoiding the use of the pearling cone. The Earle process of milling[14] is stated to be a peeling method, the action being entirely one of rubbing rather than impact. This peeling of rice is essentially a special form of undermilling which aims to limit breakage to a minimum and to retain valuable nutrients. More or less bran can be removed depending on the peeling time.

To introduce undermilled rice would necessarily imply the establishment of a standard for control in degree of milling. At present there is no ready method whereby this can be done by visual inspection. A standard requiring other than the simplest laboratory test would not be satisfactory because of lack of facilities in the warehouses and because of the excessive time that would be consumed in grading rice. Several attempts have been made to define the degree of milling precisely and data exist in the literature regarding the loss in weight of the grain in relation to the loss of ash, phosphorus, thiamin, riboflavin, niacin and fat in the course of the milling process.[6,7] No correlation could, however, be worked out between the different values and the degree of milling. Even with regard to weight of bran removed, it has been observed that the per cent. nutrient losses vary from 6 to 25 times as much as the weight loss, being greatest at the stage where the rate of weight loss is least.[9] Hence, weight loss is a very insensitive index of the degree of milling in a nutritional sense and cannot be recommended as a means of control.

Furthermore, if milling is achieved by passage through a succession of hullers, as is usually the case, it is quite conceivable that all the grains entering the machine do not get equally abraded during their passage through the hullers, any difference in the beginning being only accentuated thereafter. In practice, what the miller does is to inspect visually the rice stream flowing from each huller from time to time and to adjust it for a little looser or a little tighter milling according to some standard of colour which he endeavours to keep in mind. No doubt he acquires by training an ability to detect fine differences in degrees of whiteness but such visual standards are not susceptible of rigorous enforcement. It must, therefore, be anticipated that undermilled rice will of necessity be variable in nutritional quality.

In addition to this difficulty in adequately controlling the degree of undermilling, it is not always feasible to provide for expeditious transit of unmilled or undermilled rice from the rice-shelling mills to consumer areas and thus avoid spoilage in storage. Recent work has shown that in addition to insect infestation and onset of rancidity,[15-18] storage of rice results in loss of nutrients, being considerably more than with wheat, whether in whole grain or flour (whole or refined) form.[9,19] Storage losses would obviously be more pronounced with unmilled or undermilled rice and under tropical conditions of temperature and humidity. Hence, stability in storage presents a major problem in the rice industry and the aversion of millers to undermilled rice because of storage difficulties cannot be dismissed as mere prejudice.

The present food crisis has made it necessary, in some areas, to enforce production of undermilled rice, thereby increasing available supply of the grain; consumers have also become less meticulous in their demands because of circumstances. But for the successful development and marketing of undermilled rice as a long-term, peace-time improvement in rice quality, the foregoing problems have to be carefully considered and solved.

Parboiling of Rice

An expedient that has been much less intensively advocated than undermilling is the more widespread use of parboiled rice. The process itself is an ancient tradition and owes its prevalence and popularity presumably to the ease with which shelling and milling are facilitated by it. The grains get swollen in the process of soaking in water and steaming or boiling so that the subsequent drying operation, usually done in the sun, loosens the hulls which are thus removed readily by pounding. The observations reviewed elsewhere,[20] that there is a nutritional advantage in the parboiling of rice, was only subsequent and is still being considered as incidental. It is now generally known that parboiled rice retains, even after milling, a good proportion of its thiamin, niacin, minerals and proteins,[21,6,7] and that the nutritional merit of parboiling is due to the gelation of the starch in the endosperm with consequent imbedding of some of the bran constituents which are thus generally preserved in the kernel even after milling.[22]

Parboiled rice is customarily used in a large part of the country and, in these areas, the product is unquestionably preferred to raw rice by the people accustomed to it. The process, however, is by no means standardized.[23,24] Parboiling yields a grain of creamy to dark-brown shades and much difficulty is experienced in maintaining lightness or even uniformity of colour. There exist also flavour variations some of which are sufficiently prominent to reflect unfavourable on the universal acceptability of the rice; attempts to introduce parboiling in China under present war conditions has met with opposition on this score. The normal blandness of cooked rice and the ease with which it can be blended with other foods make it essential that, for the successful marketing of this type of rice, it should be a product neutral in flavour. Ideally prepared parboiled rice has no objectionable flavour and, while it is desirable as well as possible, to have only a light shade of colour in the finished product, it is not always essential as, after preparation in the normal manner, parboiled rice is always practically as white as regular milled rice, the yellow cast being scarcely discernable.[6]

Rice 'Conversion' Process

In spite of the knowledge, now fairly widespread, regarding the nutritional superiority of parboiled rice and the recognition that the general health of the population subsisting on

this type of rice is relatively higher than that of those who live in sections where ordinary milled rice is the staple,[5,21] there has been surprisingly little progress in process control, through technological improvements, in the production of parboiled rice. Elsewhere, however, there have been several attempts recently to modernize and improve the traditional parboiling process. The most notable among these has been the Rice Conversion Process which originated in England[25] and has been considerably developed in the United States.[26] Briefly stated, the process is as follows:

> The cleaned paddy is introduced into a large vessel which is then evacuated (to 25" or more) for a period of at least 10 minutes. Hot water (75-85° C.) to an amount about one-third greater than the weight of paddy is then introduced under a pressure of 80 to 100 lbs. per sq. inch and the rice is steeped under these conditions with recirculation of the water for a period ranging from 120 to 165 minutes. The times and temperatures required for steeping are said to depend upon the variety of rice being processed, moisture content, the length of time it has been in storage and the colour desired in the final product. The steeping water is then drained off and the steeped paddy is introduced into a large, cylindrical, rotating steam-heated vessel which is then partially evacuated and the paddy heated for a short time. At this point, dry direct steam is introduced and the paddy is heated in this manner for a few minutes. The steam is then blown off and a vacuum of 28 to 29" applied. The product is dried under vacuum in the rotating steam-jacketted vessel until a moisture content of less than 15 per cent. is attained. Final drying is done at atmospheric pressure. The hot, dry "converted" paddy is placed in bins and cooled by passing air through it and allowing it to remain in the bins for at least 8 hours before milling in the usual way.

The process has been in commercial production at Texas since 1941. A somewhat similar process, devised by Malek[27] does not readily reveal a clear distinction from the H. R. conversion process. It has also been in operation on a plant-scale in California since recently.

Claims made for the processes are (*a*) better nutritional value due to retention of water-soluble vitamins and minerals through the milling process, (*b*) resistance to infestation because of sterilisation in process and 'case-hardening' of the grain, (*c*) higher milling yield with fewer broken grains, enabling the processing cost to be met by the reduction in the proportion of low-grade rice in the output, (*d*) storage life comparable with ordinary polished rice in spite of the higher nutritive value and (*e*) better appearance when cooked, remaining as discrete particles instead of forming into a gummy mass; this property makes processed rice preferable to ordinary rice in canning.

These claims, since substantiated,[9] are all essentially those acquired during parboiling.[28,6] Further, it is reported that the H. R. process is definitely superior to the Malek process.[29] Time and experience can alone show whether this process so highly successful in the United States where the rice industry is relatively highly mechanised and where there is no dearth of technically skilled personnel, can be made feasible in our country and, what is more important, offer distinct advantages over the indigenous methods now in use.

ARTIFICIAL ENRICHMENT OF RICE

Another direction in which nutritional improvements in rice are effected has been through artificial fortification or enrichment of the cereal. Here again, the experimentation so far known has been from the United States and has not reached the stage of application to nutritional reform in rice-eating countries. The problem of enriching rice nutritionally is beset with many obstacles. It is more difficult to restore vitamins and minerals to white rice than to flour as in "national"[30] or "enriched"[31] flour because rice is rinsed before cooking. This leads to great losses when vitamin and mineral preparations are applied only to the surfaces of grains. Enrichment must, therefore, be internal if it is to be thorougly effective; in other words, the entire grain has to be impregnated with the nutrients to avoid their loss during rinsing preparatory to cooking. With undermilling or parboiling of rice, at least a portion of the nutritionally valuable factors of the grain is retained in the grain as consumed. On the other hand, it has been contended that both procedures attempt to make use of the natural nutrient content of the unmilled rice which in itself is limited and varies considerably depending upon soil, climatic, varietal and manurial factors under which the rice has been grown. Hence, it is not possible to get a rice "nutritionally well-rounded". Looking at the problem in this way, artificial enrichment of rice merits consideration provided of course it should prove to be feasible.

The problems involved in the enrichment of rice are that (*i*) the rice shall be prepared in a manner which is commercially feasible and practical, (*ii*) the enriched product shall be stable to conditions of transportation, storage and household manipulation (washing and cooking) and (*iii*) the enriched product shall preferably be indistinguishable from polished rice. These objectives have been achieved by a special process* developed in the Roche Laboratories[32] in which the enrichment is performed in two steps by (*a*) producing a fortified premix, and (*b*) diluting the premix with ordinary white rice in a subsequent process.

The premix or rice concentrate consists of ordinary polished or unpolished rice to which the fortifying ingredients are added and covered by a film-forming, edible, water-insoluble coating. When the enriched rice is cooked, the coating softens and disperses so that the nutrients are readily available in the cooked rice. The premix can obtain enough amounts of the vitamins and minerals so that one half pound will enrich 100 pounds of rice to desired levels. The solvents used for coating according to the

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* The author is indebted to Dr. T. J. T. Wells, Chief of the Roche Scientific Division Volkart Brothers, India, for this personal communication.

Roche process are not objectionable from the standpoint of being explosive or highly inflammable. The coating substances have been investigated from the food angle and found to be satisfactory.

The blending of premix with white rice in the rice mills results in the final market form of enriched rice. It has been determined that the premix is homogeneously distributed throughout the finished enriched rice. Usual household washing of enriched rice prior to cooking will not remove more than 3 to 5 per cent. of the incorporated vitamins. Flavour and cooking quality are not also affected by the fortification procedure. It has been claimed that storage of the premix or of enriched rice for one year at room temperature did not affect the potency of the vitamins.

Another method of artificial enrichment, recently reported,[33] involves impregnating the rice, polished in the conventional manner, with a water solution of vitamins (thiamin, niacin and a highly soluble salt, primary sodium phosphate). The rice is dried and coated with a thin collodion membrane. The vitamins are now protected from rinsing losses but are available to the body in the cooked product since the film is removed by the hot water. The rice is prepared with a high vitamin concentration and then diluted 1:100 with unenriched white rice.

Artificial enrichment can obviously be effected by addition of nutrients to any desired level called for by public health considerations; further, from an economic standpoint, only 1 to 2 per cent. of the rice requires special processing. On the other hand, with any form of parboiling, the total produce has to be processed whereby it may happen that the processing and drying costs may equal to or exceed the cost of fortifying ingredients. Frequently, however, it happens that the improved milling and storage qualities of parboiled rice ensures its better saleability. Parboiling can also be extended to freshly harvested paddy which otherwise requires storage or 'curing' for some months before the rice from it becomes fit for consumption.[34]

Another factor requiring careful evaluation with enriched rice is the price for the coating ingredient which should not exceed the cost of the vitamins which it is intended to save; on the basis of available figures, it would appear that over half the cost of processing go for the protective coating; besides, the stability of the premix and of enriched rice over a wide range of storage conditions such as exist in the tropics has to be studied.

Resume

It is significant that the problems of improvement and product development in rice have received attention mostly in the United States and that during the last four years. This is no doubt a direct consequence of the advent of World War II involving the principal rice surplus areas in the East: Indo-China, Burma and Siam and the recognition by the leaders in America of the anticipated demand for rice for army and civilian feeding requirements. Admittedly, the importance of the nutritive value of rice in India surpasses any relative need in the west for control of rice quality. With the aftermath of the war and the threatened world shortage of cereals engaging the attention of the United Nations Organization, it is to be hoped that concerted efforts will be made in India towards raising the status of the rice diet. Quite apart from improvements in selection of varieties and in cooking methods, which can only be achieved by re-education, the corrective measures discussed above are (*i*) encouragement of undermilled rice, (*ii*) extensive use of parboiled rice with reasonable technical control in production and (*iii*) artificial enrichment.

Enforcement in the production of undermilled rice is handicapped on account of the difficulty in controlling the degree of undermilling and of preventing deterioration in storage. Again, although undermilling increases nutritional quality, it does not give the colour or cooking quality required by many consumers and will not attain the equal digestibility of white rice.

There is paucity of information on the practical application of the principles of rice enrichment under tropical conditions. The large-scale synthetic production of vitamins in America and the extensive propaganda by leaders in the nutrition field towards restoration and fortification of certain foods have made the American people definitely nutrition-conscious with the result that they pay attention to enriched values and watch the labels in food packages for vitamin declarations. Conditions in this country are quite different and even if fortification were made possible through import of the necessary protective factors it would be a long time before such enriched foods become popular except when introduced compulsorily and under Government subsidy in which case economic factors are to be carefully reckoned.

The widespread utilization of parboiled rice undoubtedly offers advantages but it becomes absolutely necessary to effect technological improvements and product control before parboiling can be expected to yield an ideal product which combines in it the pleasing appearance and keeping quality of polished rice with the superior nutritive value of unpolished rice.

It is indeed difficult to prescribe the final answer. But, whether it be undermilling, parboiling or fortification, there is no denying the fact that whatever can be done for the nutritional improvement of rice will be well justified by enormous benefits through diminished malnutrition. For better nutritional welfare and widespread dietary improvement, it is the staple food that has to be improved in quality. It is only then that the lower income groups whose total diet contain the largest proportion of cereal foods and who are, therefore, in greatest danger from nutritional deficiencies, get the best advantage.

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A HOME-MADE INFRA-RED SPECTROMETER

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WHILE great advances have been made of recent years in the technique of infra-red spectroscopy, little work is being done on the behaviour of crystals in this interesting region of the spectrum. Infra-red investigations of crystals should provide us with fundamental knowledge about the dynamics of the atoms composing them and are essential for a proper understanding of the nature of the solid state of matter. Great interest centres round the infra-red spectrum of diamond in particular, since this is the simplest of cubic crystals. Fortunately, the most interesting region in the infra-red spectrum of diamond lies in the near infra-red and is capable of being explored with a rocksalt-prism spectrometer. Two years ago the investigation of the infra-red spectrum of diamond was undertaken by the writer at the suggestion of Sir C. V. Raman. Since there was no infra-red spectrometer available in this laboratory, it was necessary to set up an instrument for this research. With the home-made instrument which has resulted, it has been possible to establish some important facts about the infra-red spectrum of diamond. A description of the construction of the instrument, which may be of interest, is given below.

As a source of continuous infra-red radiation a globar is used. Though the widely used Nernst filament has got a higher operating temperature and consequently higher infra-red radiancy, the globar, in virtue of its large heat capacity, serves as a very steady source. The ¼″ thick 6″ long globar element now being used is mounted inside a water-cooled iron jacket cut with a slit 1″ by ¼″ in the centre for the exit of radiation.

The arrangement of the optical parts of the spectrometer is indicated in Fig. 1 (not to scale), which is self-explanatory. The spherical glass mirrors M_2 and M_4 which are of 10″ focal length and 3½″ diameter were obtained

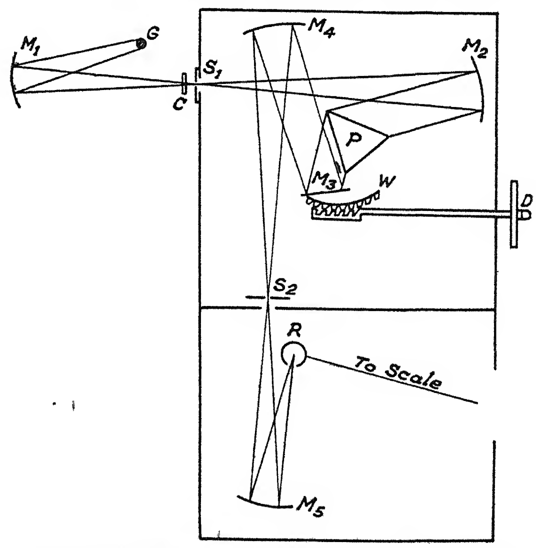

FIG. 1.—*Arrangement of the Home-Made Spectrometer.* G.—Globar, M_1 and M_5—Focussing mirrors; C—Crystal under investigation; S_1—Entrance slit; M_2 and M_4—Spectrometer mirrors; P—Rocksalt prism; M_3—Plane mirror; W—Worm wheel; D—Graduated drum; S_2—Exit slit; R—Radiomicrometer.

from Dr. Parameswaran of Trivandrum and aluminized by the writer. The plane mirror M_2 is 2" by 3" and the focussing mirrors M_1 and M_3 are of 3" diameter and 5" focal length. They were all coated with a strongly reflecting film of aluminium by the well-known evaporation technique. The rocksalt prism P (with a refracting angle of 53° 30′ and faces 2" square) was cut, ground and polished from a big crystal in Sir C. V. Raman's collection. The optical parts are all enclosed in a urelite box 12" by 12" by 10". A worm wheel W, attached to the prism table, is capable of being rotated by very small amounts (28 seconds of arc at a time) from outside the box by means of a graduated drum attached to the rod engaging the wheel.

A Boys' radiomicrometer R, also constructed locally, is used for detecting the radiation. The instrument is fitted with a rocksalt window to make it air-tight. The deflections of the instrument on a scale at two metres distance are of the order of 6 centimetres in the 8 μ region of the spectrum with a slit width of a quarter of a millimetre.

The infra-red absorption curves of four typical diamonds obtained with the above instrument are reproduced in Fig. 2. They show very well the differences in the structure and intensity of the 8 μ band for diamonds which differ in their luminescence properties. The band is most prominent in the weakly blue-fluorescent diamond (Curve *a*, N.C. 71, 0·78 mm. thick), less prominent in the strongly blue-fluorescent diamond (Curve *b*, N.C. 79, 1·20 mm. thick), least prominent in diamond N.C. 110 luminescing blue and yellow with great intensity (Curve *c*, 0·80 mm. thick), and altogether absent in the non-luminescent diamond N.C. 60 (Curve *d*, 1·27 mm. thick). While all the diamonds show in the 5 μ region the octaves of the peaks appearing in the 8 μ band, the general lack of detail in this region is due to the inadequacy of dispersion of rocksalt. On the other hand, the dispersion in the 8 μ region is sufficient to show up a great deal of detail, as is seen from the curves reproduced. Along with several other maxima, the curves show the well-known 1332 cm.$^{-1}$ Raman frequency

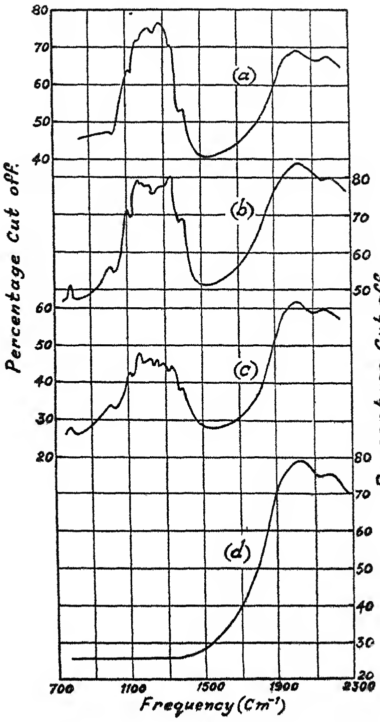

FIG. 2.—*Infra red Absorption Curves of Diamonds.*

(*a*) Weakly blue-fluorescent diamond. (*b*) Intensely blue-fluorescent diamond. (*c*) Diamond fluorescing blue and yellow with great intensity. (*d*) Non-fluorescent diamond.

as an absorption peak. The positions of this and the other peaks agree well with the lattice frequencies of diamond determined from its luminescence and absorption spectra.

MERCURY STANDARD OF WAVE-LENGTH

THE best wave-length standard of the near future will no longer be the red cadmium line which has been standard since 1893, but a green line due to a mercury isotope transmuted from gold. *Science Service* reports on the work done by Drs. Jacob H. Wiens and Luis Alverez, who used the cyclotron of the University of California to bombard atoms of gold with neutrons. When the gold atoms capture neutrons they become radioactive and after emitting electrons become mercury of atomic weight 198, with a purity better than one atom in a million. This purity is reflected in the sharpness and clarity of the spectrum line, which does not vary by more than one 50-billionth of an inch in wave-length.

This mercury line is further superior to the cadmium standard because the mercury can be brought to incandescence at a much lower temperature—actually below freezing, whereas cadmium must be heated to 300° C. Also, mercury atoms, being heavier, do not move about as fast when heated. Both the mass and the temperature of atoms influence the sharpness of spectrum lines; needless to say, the sharper a line is, the more accurately it can be measured.

—Courtesy of *Sky and Telescope*, 1946, 5, 10.

SOME OBSERVATIONS ON SUGARCANE MITE AND ITS EFFECTIVE PREDATOR IN SIND

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BIOLOGICAL control of insects has gained great importance in recent times and attempts are being continually made in several countries to take the fullest advantage from parasites and predators of insect pests in their control. While some attention has been paid to the study of parasites of crop pests in India, their predators have been very little studied. Recently, however, Rahman (1940) has summarized the information available on important predators of India and Kapoor (1942) has studied the role of a number of predators found in the environs of Delhi, while Trehan (1943) has discussed in general the role of predators in biological control.

During the course of survey of crop pests at Sakrand (Sind), a very effective predaceous beetle, *Scymnus gracialis* Motsch, was observed feeding on the sugarcane mite, *Paratetranychus indicus* Hirst, in June 1943. Although sugarcane had been grown for experimental purposes at the Agricultural Farm, Sakrand, for nearly fifteen years, neither this pest nor its predator was observed here before, and neither of these was even reported from any other part of the province. Though recorded for the first time from Sind, *P. indicus* is widely distributed in other parts of India (Rahman and Sapra, 1940), while *S. gracialis* has so far been reported from Coimbatore and Lyallpur (Rahman, 1940).

The attack of this mite was first noticed on 5th June in a small area, about ⅛ of an acre, in the southern corner of sugarcane block; the pest had probably migrated from a wild grass, *Sorghum halepense*, growing some 40 feet further south. The attack progressed rapidly on sugarcane and by the first week of July the whole of the adjoining area under this crop, about 10 acres in size, was so heavily infested that it seemed the entire crop would be destroyed in a short time.

With a view to have some idea of the severity of the pest, a method somewhat similar to the one utilized by Le Pelle (1942) to determine the relative abundance of thrips was tried. By this method 10 heavily and 10 mildly infested leaves were taken at random on 8th July and from about the middle of each leaf, one square inch area was cut and put immediately in a glass tube containing 70 per cent. alcohol. All adults and larvæ of the mite that were killed were later counted; the maximum number of these found per square inch leaf-surface was 275, the minimum 45, and the average of all twenty counts was 128.

It was interesting to watch the progress of attack of this pest. The attack started in the extreme south corner of the sugarcane block and progressed northwards, along the entire length of the area which was about half a mile. It took just three weeks for the pest to reach the extreme northern portion of the block where it was first noticed on 28th June. At this stage, there were all grades of infestation from an extremely heavy infestation in the extreme south to a negligible one in the extreme north. Although the rate at which the infestation progressed was not properly recorded, it appeared from the general survey made that its progress was fairly uniform and may have varied from about 35 yards to 50 yards per day.

The dispersal of the pest was greatly, if not entirely, facilitated by wind. The direction of wind during June and July was from south and south-west to north and north-east, and the attack progressed in the windward direction; the plots on the extreme south being the first to be attacked and those in the extreme north to be attacked last. The mean velocity of wind during June and July was 6-8 miles per hour, but at times it used to be as high as 20 miles or even more.

In all fifteen improved varieties of sugarcane were grown in this block for varietal and sowing date trials. The principal varieties need only be mentioned, and they were Co. 213, Co. 312, Co. 313 and Co. 450. The sowing dates were middle October, middle November and from the middle of February to the middle of March. All these varieties, grown on different dates were badly affected. It was not possible to make detailed observations on the incidence of the pest either in relation to varietal susceptibility or date of sowing because of the number being very large, but from the surveys conducted it seemed that there was little or no difference in the intensity of attack.

The nature of damage done by this mite is somewhat different from what has been recorded by Rahman and Sapra (1940). The leaves did not turn red due to mite attack, but became dry and straw coloured. The mid-rib and some portions on both sides of it remained green and unaffected by this mite. The yellowing of leaves usually started from the tips and progressed towards the base of the leaves. The pest was usually found on the underside of the grown-up leaves, very young leaves were rarely attacked.

Towards the end of June a predaceous beetle, *Scymnus gracialis* Mots., was observed in the plots on the extreme south feeding on the pest. This predator was found in all stages, and both the larvæ and the adults were observed feeding on the various stages of the pest. At first the predator was present in small numbers, but within about a week, from 3rd July onwards, it increased very much in numbers, either owing to considerable migration from outside or because of multiplication or both. It started following the pest from plot to plot, with the progress of the attack. Towards the end of the second week of July the crop in the first attacked area showed signs of revival and on 16th July three acres of sugarcane were

absolutely free from the mite. Owing to such a phenomenal control, through this natural agency, some observations on the population of the predator were made. Twelve leaves of sugarcane were taken at random on 16th July with the consideration that they had large number of either larvæ or adults of the predator present on them. The maximum number of larvæ found on a single leaf was 36 and that of adults was 94. The average of various stages, except eggs, found were 10 larvæ, 11 pupæ and 35 adults.

The final stage in the drama was reached on 29th July when the entire sugarcane block was found free from mite, and only a very small number of pupæ of the predaceous beetle and some adults were found scattered in the plots last affected.

This predator thus seems to possess all the desired characters of an efficient agent in the biological control. It preyed on all the stages of the pest, a single adult consumed as many as 50 mites in 24 hours, and it multiplied in a very short time. From the observations made subsequently, it appears that this predator remains active almost all the year round. During June and July it was found, as stated above, on sugarcane, in September it was observed feeding on *Paratetranychus indicus* attacking a wild weed, *Digera arvensis*, in October its adults were noticed feeding on a scale insect on *Dalbergia sissoo*, and again in February-March 1944 it was found feeding on *P. indicus* infesting *Sesbania ægyptiaca* and *S. grandiflora.*

The host plants of this mite have been recorded from South India (Cherian, 1933) and the Punjab (Rahman and Sapra, 1940). None of them, however, found it on the three hosts, *Digera arvensis, Sesbania ægyptiaca* and *S. grandiflora,* recorded in Sind.

It is not possible to indicate all the environmental factors that may have favoured the increase of either the host or the predator, but it was interesting to observe that very hot and dry conditions prevailed during June-July 1943 while both of them were found in very large numbers. The mean maximum temperature of June was 109° F., the highest temperature reached was 123° F. on two days, the mean minimum was 85° F., and the mean relative humidity was 58 per cent. at 8-30 hours. During the first ten days of July the climatic conditions were equally severe, but with a few small showers of rain from 11th July onwards the temperature fell down and the mean maximum for the remaining period was 103° F. with a mean relative humidity of 69 per cent. at 8-30 hours. There was no rainfall in the month of June, but 0·5 inches was recorded in the last three weeks of July.

It is interesting to record that Rahman and Sapra (1940) also found this mite very common on sugarcane during hot and dry months of May and June at Lyallpur, where the setting in of monsoon rains in July kills all the stages of the pest except the eggs. At Sakrand, as stated above, the pest was entirely controlled by the predator, and the rainfall received during the two months of its activity was negligible.

This short note is written in the hope that it will stimulate the study of the relationship of pests and their enemies under natural conditions. One often records the severe outbreaks of pests and tries to explain their causes, but little attention is paid to the role of parasites and predators in suppressing them. Some of the useful natural enemies, such as *S. gracialis,* hitherto considered of little importance in the biological control, may turn out to be of great value.

We are indebted to Dr. Taskhir Ahmad, Second Entomologist, in charge of the Division of Entomology, for giving facilities in writing this note and for help in revising it.

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1. Cherian, M. C., *Madras Agric. J.*, 1933, **21**, 1–6. 2. Kapoor, A. P., *Ind. J. Ent.*, 1942, **4**, 49–66. 3. Le Pelley, R. H., *Bull. Ent. Res.*, 1942, **33**, 147–48. 4. Rahman, K. A., *Proc. Ind. Acad. Sci.*, 1940, **12**, 67–74 5. Rahman, K. A., and Sapra, A. N., *Ind. J. Ent.*, 1940, **2**, 201-12. 6 Trehan, K. N., *Curr. Sci.*, 1943, **12**, 223–25.

COLLECTION OF MALAYSIAN HEPATICÆ

THE Farlow Herbarium of Harvard University has received word that a valuable collection of over 3,000 specimens of Malaysian hepaticæ, chiefly Epiphytic Lejeuneaceæ, gathered by Dr. Frans Verdoorn as well as some other collections assembled by him between 1925 and 1926, which were on loan, at the outbreak of the War, to the Botanical Institute of the University of Jena, is safe. Professor Th. Herzog who, with a number of assistants and graduate students, is working on this collection, writes that he placed most of it during the early war years, for safeguarding in a country home near Jena. This house was almost entirely destroyed by a bomb, the specimens, however, were found in undamaged condition in the wreckage of the basement. They were removed subsequently to a part of the basement at the Botanical Institute. This building and most of the basement were entirely destroyed at a later date when nine students were killed and the Director, Professor Renner, was seriously wounded. The bryological collections were fortunately in a wing where the basement withstood the bombing and work on them is now being continued by Prof. Herzog and his assistants, Drs. Benedict and Schuchardt.

—Courtesy of Dr. Frans Verdoorn, Editor, *Chronica Botanica.*

LETTERS TO THE EDITOR

ON THE VARIATION OF THE ELECTRICAL CONSTANTS OF SOIL WITH THE FREQUENCY OF THE MEASURING FIELD

Two possible causes of polarisation in the soil condenser are—(*a*) the formation of an ionic space charge and (*b*) the orientation of the dipolar molecules in the soil medium. From White's[1] charge and discharge curves the effect of the ionic space charge was shown to have practically no effect except at very low audio frequencies. The variation of the soil constants should thus be attributed to the polarisation caused by dipolar molecules in the soil medium, especially in the region of high frequencies. In the range of audio frequencies, however, the variation of the soil constants due to orientation of molecules is of little importance and so far as the electrical conductivity is concerned, we have to consider the effect of the displacement currents in the soil medium as causing the major portion of soil conductivity. Thus the total electrical conductivity of soil at any frequency of the measuring field can be represented by

$$\sigma = \sigma_0 + \sigma_d + \sigma_p \tag{1}$$

where $\sigma_0 =$ d.c. electrical conductivity.

$\sigma_d =$ electrical conductivity due to displacement currents in the dielectric.

and $\sigma_p =$ electrical conductivity due to orientation of polar molecules in the electrical field.

Let us first determine the expression for the electrical conductivity due to the displacement currents. If E_s is the sinusoidal potential difference across the soil condenser and E the electric field intensity at a point in the soil medium of dielectric constant ϵ, then taking the displacement along x-direction, the displacement current density would be given by

$$i_d = \frac{\epsilon}{4\pi}\frac{dE}{dt} = -\frac{\epsilon}{4\pi}\cdot\frac{d}{dt}\left(\frac{dE_s}{dx}\right). \tag{2}$$

Assuming a small space-charge in the soil condenser, so that the voltage gradient at any instant remains practically unaffected, we can write

$$\frac{dE_s}{dx} = a \sin \omega t,$$

where a is a constant and w the angular frequency of the voltage. Thus

$$i_d = \frac{\epsilon}{4\pi}\cdot \omega . a \cos \omega t$$

$$= A \cos \omega t, \quad \text{where } A = \frac{\epsilon . \omega . a.}{}$$

Consider now a small cylindrical element of the current-path in the soil condenser. Let the length of the element parallel to the direction of the current be dl and the cross-section perpendicular to the current path be da. If σ_d is the specific conductivity due to the displacement currents, the power dissipation in this small element is given by

$$(i_d\cdot da)^2\cdot\left(\frac{1}{\sigma_d}\cdot\frac{dl}{da}\right) = \frac{i_d^2}{\sigma_d}\cdot(dl\cdot da)$$

when averaged over one cycle, the power dissipation in the element is

$$dP = \overline{i_d^2}\cdot\frac{dl.da}{\sigma_d} = \frac{A^2}{2\sigma_d}\cdot(dl.da) \tag{3}$$

The power dissipation can also be written as

$$dP = \sigma_d . E^2 . (dl.da) = \sigma_d \cdot \frac{a^2}{2} \cdot (dl.da) \qquad (4)$$

since

$$E = -\frac{dE_s}{dx} = -a \sin \omega t.$$

Hence from (3) and (4)

$$\sigma_d = \frac{A}{a} = \frac{\epsilon.\omega}{4\pi} = k_1 \cdot f, \left(\text{where } k_1 = \frac{\epsilon}{2}\right) \qquad (5)$$

and f = frequency.

In the audio-frequency range, the contribution of the displacement current to the electrical conductivity is much more pronounced than that due to orientation of the soil molecules. Thus the A.F. electrical conductivity will be virtually of the form

$$\sigma = \sigma_0 + k_1 \cdot f. \qquad (6)$$

This has been substantiated by all workers employing audio-frequency currents.

Regarding the expression for the electrical conductivity due to the dipolar orientation, Debye obtained

$$\sigma = (\epsilon_1 - \epsilon_0) \cdot \frac{\omega^2 . \tau . \left(\frac{\epsilon_1 + 2}{\epsilon_0 + 2}\right)}{1 + \omega^2 . \tau^2 . \left(\frac{\epsilon_1 + 2}{\epsilon_0 + 2}\right)^2}, \qquad (7)$$

and also

$$\epsilon = \epsilon_0 + \frac{\epsilon_1 - 2}{1 + \omega^2 . \tau^2 . \left(\frac{\epsilon_1 + 2}{\epsilon_0 + 2}\right)^2}, \qquad (8)$$

where ϵ_0 = constant value of the dielectric constant at high frequency or optical dielectric constant,

ϵ_1 = Static dielectric constant for extremely low frequency,

τ = relaxation time

and w = angular frequency of the measuring field.

According to White, the relaxation time τ for Cambridge soil is about $\cdot 4 \times 10^{-7}$ or 5×10^{-7}, so that even in the radio-frequency range where $w \lesssim 10^6$, $\omega . \tau << 1$. When $\omega \cdot \tau << 1$, the Debye expressions would be reduced to—

$\sigma \propto \omega^2 = k_2 \cdot f^2$, where k_2 is some constant,

and ϵ = constant for all frequencies.

Thus under the restricted condition $wT << 1$, the total conductivity of soil would be of the form

$$\sigma = \sigma_0 + k_1 \cdot f + k_2 \text{-} f^2. \qquad (9)$$

Bairsto's[2] work substantiated this relation in the case of marble and slate.

There is yet another effect for our consideration, especially for high values of d.c. conductivity and for the higher frequency range—the skin effect. Considering the skin effect, we can write for the total conductivity of the soil thus:

$$\sigma = \frac{k_0}{\sqrt{f}} + k_1 \cdot f + k_2 \cdot f^2. \qquad (10)$$

where k_0 involves the d.c. conductivity.

For extremely high packing, the skin effect is most prominent. The electrical conductivity of soil is, therefore, expected to decrease with the increase of frequency, whereas for lower degrees of packing, when Debye's dipole effect plays an important part, the electrical conductivity is expected to increase with frequency. For some suitable degrees of packing, an increase of the electrical conductivity followed by a subsequent decrease may also be expected with the increase of frequency.

The variation of the dielectric constant with frequency should, however, be attributed solely to the orientation of the dipolar molecules in the soil medium.

Some of the above theoretical conclusions on the variation of the electrical constants of soil with frequency were substantiated by experiments[3] performed by Amalendu Banerjee in this laboratory with different soil specimens packed to various extents. Some typical experimental results for high and low packing with different soil specimens (Calcutta, Dacca and Delhi soils) are shown in Figs. 1 and 2.

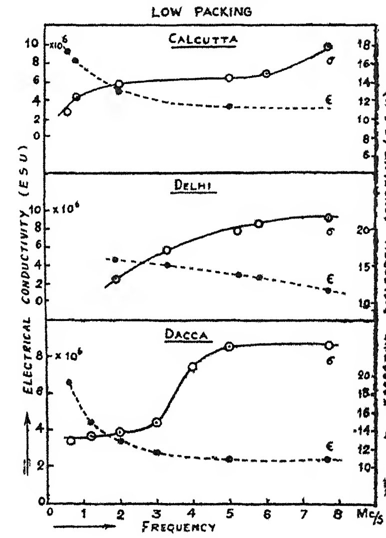

FIG. 1

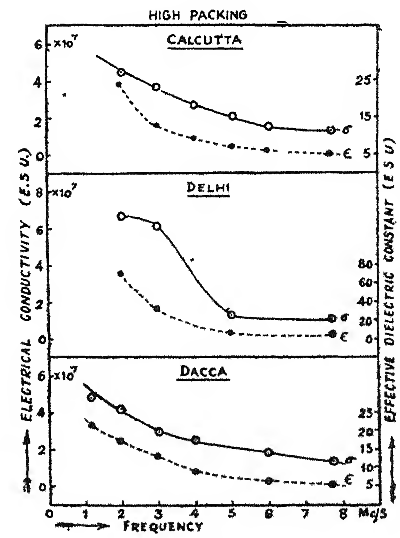

FIG. 2

The measurements of the soil constants were made by the oscillographic method over a

range of frequencies from 2 to 8 Mc./S. Fig. 1 refers to measurements with soils with a low packing, while Fig. 2 refers to a very high packing (4,500 lbs. per sq. inch). It is to be noted that the electrical conductivity of the soil, in the first case, increased with a frequency tending in some cases to a saturation value and that, in the second case, it decreased steadily with the increase of frequency. It can be said that the former illustrates the effect of dipolar molecules and the latter result is due to the preponderance of the skin effect at such high packing when the d.c. conductivity is, indeed, considerable. In both cases, however, the *effective* dielectric constant of the soil decreased with the increase of frequency over the range under investigation.

Dacca University,
Ramna, Dacca, S. R. KHASTGIR.
May 20, 1946.

1. White, *Proc. Camb. Phil. Soc.*, 1931, **27**. 2. Bairsto, *Proc. Roy. Soc.*, 1912, **A 96**, 363. 3. Unpublished work of Khastgir and Banerjee.

ON THE VISUAL LIGHT CURVE OF RT. ERIDANI

THE long-period variable RT. Eridani was first announced as variable in Harvard Circular 135, and the elements were derived by Zinner[1] based on observations made between the years 1912-1920 as

Max. J.D 2420060 + 380 days.

Miss Dwyer[2] from a study of Harvard plates taken between 1897 and 1928, an interval during which time she was able to obtain 27 maxima, finds an abrupt change in the period of this star since 1918. Her elements are

1897-1918 Max. J.D 2414900 + 366 days.
1918-1928 Max. J.D 2418562 + 378 days.

The star was on the regular variable star programme of the Nizamiah Observatory, Hyderabad, from 1924 onwards, and since then 242 observations were made till 1944, with the aid of the fifteen-inch Grubb Equatorial and three-inch finder. The elements derived from 4 fairly well observed maxima and 8 minima are

Max J.D 2424217 + 368 days.

The period obtained from observations extending from 1924 to 1944 is thus 368 days. Taking into account Miss Dwyer's period of 378 days derived from the observations covering the interval 1918-1928, the variable seems to have recovered nearly its former period.

The individual light curves show that the maxima vary between 8·6 m. and 9·9 m., and that the minima are broader than the maxima; the minima also fluctuate between 12·2 m. and 12·8 m. The star therefore varies over a range of about four magnitudes.

The mean light curve (Fig. 1) indicates a hump on the way to maximum. The rate of ascent is greater than that of descent, the ratio of ascent to descent being 0·72. The star can therefore be considered to be of Type Cd (Campbell's classification of Long-Period Variables).[3]

The lack of observations on the descending branch is due to the fact that the period is nearly a year. By the time the variable reaches the maximum, its proximity to the sun, and later the onset of monsoons, prevent any observations being made on the descending branch, for this part of the period.

According to Miss Dwyer the interval between maximum phase to minimum phase is about 200 days. From an examination of the individual light curves of the variable, the

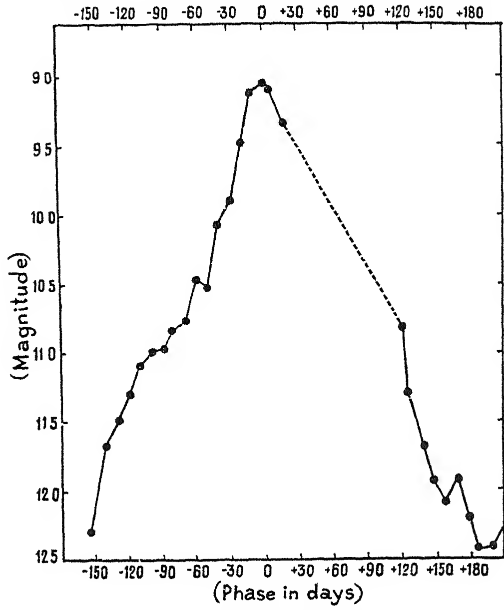

FIG. 1.—Mean light curves of RT. Eridani.

minima have been seen to follow the maxima roughly between 210 and 218 days. The humps in the light curves also fluctuate between 9·5 and 11·7 magnitudes. An interesting correlation has been noticed between the maximum magnitude of the hump and the corresponding maximum of the star, which is diagrammatically shown in Fig. 2.

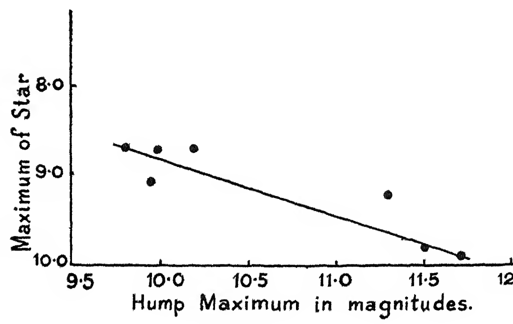

FIG. 2

Details regarding observations, etc., will be published elsewhere.

The author takes this opportunity to express his gratitude to Dr. Akbar Ali, Director, Nizamiah Observatory, for having kindly provided facilities and for his valuable guidance.

Begampet,
Deccan,
June 4, 1946.
M. K. VAINU BAPPU.

1. Zinner, *V.J.S.*, **51,** 260, 270. 2. Miss Dwyer, *Har. Bull.*, 868. 3. Campbell, H. A., 1907, **57,** 1.

RAIN FORMED IN LOW CLOUD MUCH WARMER THAN 0° C.

T. BERGERON,[1] while admitting that drizzle can occur from Cumulus clouds which are not high enough to be at 0° C. or less in temperature, believes that all rain-drops originate as snowflakes or as ice-crystals, *i.e.*, are formed at much greater heights.

On the other hand, that rain-drops also form at much lesser heights, *i.e.*, without having been through a solid phase, at any rate in tropical and sub-tropical conditions, was well shewn by three light showers that occurred in Nagpur, lat. 21½° N., approximately, in the early hours of the 16th April 1946.

Associated with a weak and somewhat distant front, Stratocumulus clouds at an average height of about 3,000 feet above ground were slowly drifting from WSW to ENE. There was an almost full moon, which, therefore, between 3-30 and 4 hours, when the rain occurred, was fairly high in the heavens. One could see by it that the Stratocumulus cloudlets were of no great depth. Most of them had only the lightest shadows under them. Their depths may have been 500, certainly not more than 1,000 feet. And *above them the sky was clear.*

At least three light showers fell from these passing clouds, all consisting of medium-sized droplets; (no filter-paper impressions could be taken).

The amount of precipitation could not be measured. But it was sufficient to wet evenly a linen bed-sheet which covered me—I was sleeping in the open—and then just begin to drip through. An estimate of the amount would be 1 cent.

None of this rain could have originated above the freezing level, which at 07 hours was 11,000 feet a.s.l. All of it had obviously been formed in the shallow Stratocumulus layer and had dropped directly down from it. Clouding had commenced only a little while before. At 23 hrs. on 15th it was ·1 Cirrus, at 24 and 01 hrs. there were only traces of Stratocumulus, at 02, 03 and 04 hrs. ·7 Stratocumulus and ·2 to ·3 Altocumulus, and at 05 hours only ·4 Altocumulus. The pilot-balloon ascents nearest in time to this precipitation, *viz.*, of 00 and 07 hours, showed that at 00 hours the somewhat moister WSW current was not thicker than from surface upto 2,000 feet a.s.l., *i.e.*, only 1,000 feet thick (Nagpur being 1,010 feet a.s.l.), the winds above that being 350°, 6 m.p.h. at 3,000, and 30°, 11 m.p.h. at 5,000 and 7,000 feet; whereas by 07 hours these upper winds had also become WSW-W upto about 6,000 feet. The latter were at 2,000 feet, 230°, 20 m.p.h.; at 3,000 feet, 240°, 15 m.p.h.; at 5,000 feet, 260°, 10 m.p.h.; at 7,000 feet, 310°, 5 m.p.h.; at 10,000 feet 330°, 11 m.p.h;, showing a remarkably smooth transition in both directions and speeds from a substantial WSW'ly (somewhat moist) current at the surface upwards to a N'ly (very dry) current from perhaps 6,500 feet a.s.l. upwards.

Thus it seems pretty evident that at halftime between these two observations, when the rain occurred, the upper limit of the WSW'ly air was at about 3,500 or 4,000 feet, *just where the Stratocumulus clouds had formed.*[2]

H. Kohler has shown from classical theory[3] that above a certain very low limit, cloud-droplets do not increase to larger sizes, or to raindrops, by condensation of more water-vapour on them—because with their curvature, vapour-pressure and reduced salinity on reaching those sizes, further condensation cannot take place on them—and that all growth thereafter to the sizes we are able to perceive as clouds is by *coalescence.* This has been found by me—from a few thousand measurements in monsoon clouds—to be entirely borne out, and I have been able to find additional groups of droplet-sizes (to the four groups found by Kohler in the clouds and fogs of Scandinavia and of Switzerland), and have found coalescence taking place actually *while* observations at short regular intervals were being made in a few clouds.

Rain-drop measurements also show these, or similar groups of sizes—though, of course, their sizes are all intrinsically very much larger.[4] Moreover, considerable time always elapses between the formation of a cloud and precipitation from it. There seems to be no reason, therefore, why rain-drops cannot also, like the larger cloud-droplets, be formed mainly by progressive coalescence of the latter under favourable conditions of convection, small eddies, electric charges, etc., within the clouds.

Regional Meteorological Centre,
Nagpur,
April 22, 1946.
K. J. KABRAJI.

1. *Report of the Lisbon Meeting of the International Union of Geodesy and Geophysics*, 1933, p. 166.
2. And that the mechanism of their formation was vertical waves created in the layer between the WSW'ly and N'ly airs.
3. H. Kohler. *Gerl. Beitr. z. Geophys.*, 1913, **29,** 2, 168–85; *Trans. Faraday Soc.*, 1936, **8,** **32.** 1152–6.
4. Only if measured before loss by evaporation.

CHEMISTRY OF KURCHI SEEDS. PART III. A NEW AND SIMPLE METHOD OF ANALYSIS OF BROMOGLYCERIDES

THE isolation of the bromide of linoleo-dilinolenin from kurchi seed oil, recently reported in *Current Science*,[1] has raised the general question of the analysis of such bromoglycerides with special reference to the isomerism

of the constituent linolic and linolenic acids. It has been the practice so far among investigators in this field,[2,3] to debrominate the individual bromoglycerides to the corresponding unsaturated glycerides and rebrominating the unsaturated acids derived from them by hydrolysis, with a view to determine the nature and content of the individual unsaturated acids through identification of the bromo-derivatives. But it is well known that linolenic and linolic acids isomerise considerably on debromination and rebromination.[4] It seemed advisable, therefore, to devise a direct method of splitting the bromoglyceride into glycerine and the constituent bromo-acids. The present communication describes a successful attempt in this direction, applicable to the whole series of bromoglycerides derived from fats.

The first reagent tried for this purpose was a 4 N solution of aqueous hydrobromic acid which was, however, found unsuccessful. The second reagent which gave extraordinarily quantitative results was an 18 per cent. (by weight) solution of hydrogen bromide in glacial acetic acid specially prepared for the purpose.

0·2 G. of the bromide of linoleo-dilinolenin, m.p. 151°, obtained from kurchi seed oil,[1] was refluxed in an oil-bath with 7 c.c. of 4 N aqueous hydrobromic acid during three hours. The reaction product was diluted with water, filtered, the precipitate dried and washed with cold ether yielding 0·2 g. of product melting at 147-150° C., which proved to be the unchanged original substance.

In a second experiment 0·5 g. of the same bromide was digested at room temperature overnight with 5 c.c. of 18 per cent. hydrogen bromide in glacial acetic acid and then refluxed in an oil-bath during 1½ hours. The product worked up as before yielded 0·35 g. of a bromo-acid melting at 177-78° C., the melting point being unchanged on mixing with a pure specimen of α-linolenic acid hexabromide. The yield of the hexabromo-acid in the above hydrolysis is theoretical, confirming the original substance to be a pure linoleo-dilinolenin bromide.

The nature of the bromo-acid in the ethereal wash of the product and the exact mechanism of the splitting of the glycerine in this reaction are being studied.

Opportunity is hereby taken to correct an oversight in the theoretical bromine content of the bromide of linoleo-dilinolenin which should be 59·35 instead of 58·9 per cent. quoted in the previous communication.[1]

My thanks are due to Mr. P. Ramaswami Ayyar for suggesting the above methods and guiding the work and to Dr. P. C. Guha for kind interest.

Dept. of Pure & Appd. Chemistry,
Indian Institute of Science,
Bangalore, (Miss) R. J. Irani.
July 3, 1946.

1. *Curr. Sci.*, 1946, **15**, 161. 2. Vidyarthi and Mallya, *J. Ind. Chem. Soc.*, 1940, **17**, 87. 3. Singh and Kumar, *Proc. Ind. Acad. Sci.*, 1946, **23**, 379 4. Erdmann and Bedford, *Ber.*, 1909, **42**, 1324.

NOTES ON *CORTICIUM ALBUM* DAST. AND *C. SALMONICOLOR* B AND BR.

In 1940, a new Basidiomycetes on citrus stem was described by me and named as *Corticium album*. My colleague, Dr. B. B. Mundkur, has drawn my attention to Rogers' paper (1943) in which he says, "It appears highly probable that the fungus (*Corticium album* Dast.) is a member of the genus *Pellicularia*". Mundkur (1940) has shown that the name *C. album* is a later homonym of *C. album* Britz and so is untenable; he has also pointed out that as the new species lacks a Latin diagnosis it is to be considered as *nomen nudum*.

Being at the moment in a position to re-examine the slides and specimens of the type, the opportunity is taken of rectifying these mistakes and of seeing if the fungus is a *Pellicularia* Cooke.

Rogers (1935) from his study of the American species of *Corticium* found that they fall naturally into three groups which he has raised to specific ranks; the first group includes the most primitive of the holobasidiomycetes, for which group he proposes a new genus *Ceratobasidium*, the basidia of which can be divisible into hypo- and epibasidium; "the second group, exemplifying a further step in the evolution of holobasidial forms, constitutes the genus *Botryobasidium* Donk, characterised by its peculiar short-cylindric basidia closely resembling hyphal segments and by a unique hypochnoid fruiting layer"; the third group has urn-shaped basidia generally bearing five to eight spores.

Rogers (1943) pointed out that as the generic name *Pellicularia* Cooke, antedates *Botryobasidium* Donk, the former name has to be accepted in preference to the latter.

The fungus described by me evidently falls in the second group made by Rogers. He gives the following description of *Pellicularia*:—"Fructification resupinate, mucedinoid or hypochnoid, reticulate-pellicular, finely granulose under the lens more or less tufted, or even and loose-membranous; hyphæ strongly stainable in aniline blue, thick short-celled except for basal strands, branching at right angles and often with the formation of cruciform cells, the ascending hyphæ usually several times cymosely divided, bearing the terminal basidia in more or less candelabrum-like clusters, or in parasitic species sometimes relatively short and little divided; basidia subcylindric, not greatly exceeding in diameter the supporting cells, relatively short, bearing 4 or in several species 6-8 sterigmata; spores smooth-walled or rarely asperculate or spinulose, colorless or pale ochraceous; cystidia wanting, or present and of various forms."

The description given by me of the fungus on citrus stem fits in with the characteristics of *Pellicularia*. The fructification is resupinate; the basal layer consists of strands of long hyphæ without clamp connections and sparsely branched; above this layer is a tissue of cruciform cells, which are short, and from which arise terminal basidia in candelabrum-like structures; the basidia are clavate, and do not generally exceed in diameter the supporting

cells. The hyphæ of the material that has been preserved in rectified spirit and glycerine has been found to be distinctly stainable in aniline blue.

Unfortunately Rogers does not give the precise characteristics, of the genus *Corticium*, which should be used in its identification. If the grouping made by Rogers is accepted then the fungus under discussion clearly belongs to the second group, *viz.*, *Pellicularia*.

Rogers suggests that since the "basidia (of *Corticium album* Dast.) are longer than in most species of the genus and apparently distinctly clavate" they resemble those of *Pellicularia flavescens* (Bon.) Rogers com. nov. The basidia, however, are narrower than those of *P. flavescens* and the sterigmata and spores are also much smaller. The basidia and spores judging from the illustrations given by Rogers are entirely different from those observed by me (*cf.* Rogers, 1935, *Botryobasidium flavescens*, Pl. 2, Fig. 8; and Dastur, 1940, Pl. 1, Figs. 3-6).

If we consider the dimensions of basidia, sterigmata and basidiospores, the citrus fungus comes very near to *P. vaga* (Berk. and Curt.) Rogers ex Linder; the basidia of *P. vaga* are blunt-cylidric, and measure 13-22 (— 27) × 6·5-10 (— 15) μ; they bear rarely 4 or 5, mostly 6-8 stout, divergent, recurved sterigmata (3-) 4·5-6 × 1·5-2 μ; spores are smooth-walled, colourless, 7·5-12 (—17) × (2·5) 3·5-5 (—5·5) μ, fusoid, obliquely tapered to the apiculus. The basidia of four fungus are rounded at the apex, the sterigmata are invariably four and the spores are tapered to the apiculus but are rounded. The fructification of our fungus is distinctly snowy white when fresh and not "sordid whitish or pale buffy" as in *P. vaga*; for these reasons the citrus fungus is considered to be a new species and the new name *Pellicularia alba* is proposed.

Pellicularia alba sp. nov.

Fructificationes ad 30 cm. longæ. 10 cm. latæ, leves, lucido-albæ, tenues, resupinatæ atque adnatæ, margine plumoso; in sectione 70-300 μ crassæ, compositæ ex hyphis, hyalinis, sparse divisis, tenui pariete præditis, sparse septatis, parallellis, plus minus 3 μ in diam., compactia, longitudinaliter decurrentibus super substratum nec convolutis, producentibus latam seriem hypharum tenui pariete præditarum, laxe intertextarum, in ramulos divisarum, hyalinarum, cellulis brevibus, latis. Ex hos reticulato strato emergunt cellulæ basales, hyalinæ, tenui pariete præditæ, cylindricæ, 10·0-16·6 μ longæ, 3·3-6·6 μ latæ; ex his basalibus cellulis basidia terminaliter nonnumquam lateraliter, producuntur, hyalina, tenuiter parietata, clavata, 13·3-25·0 longa, 6·6-10·0 late in apice: sterigmata 4, brevia, hyalina, lata ad basim, tenuescentia ad apicam, 2·5-5·0 × 0·5-2·5 μ. Basidiosporæ hyalinæ, ovatæ, rotundæ in apica, acutæ ad basim, nonnumquam uno latere planæ, 8·3-10·3 × 3·3-5·0 μ. Gœocystidia absunt; hyphæ haud incurustratæ.

In cortice trucorum viventium *Citri aurantium.*

It would not be out of place here to consider the nomenclature of *Corticium salmonicolor* B. & Br. This fungus, at least the one studied by me (1941), is structurally a *Pellicularia*, as is evident from the detailed description and illustrations given by me. I have also examined the specimens labelled *Corticium salmonicolor* B. and Br. and available in the *Herb. Crypt. Ind. Orient.*, New Delhi, on *Hevea brasiliensis* (collected from Travancore in September 1909 and from Burma in July 1915), *Citrus* sp. (collected from Coorg in September 1942) and *Acacia arabica* (collected from the Punjab in August 1944). These specimens are all identical. Therefore, the name *C. salmonicolor* B. and Br. needs to be replaced by *Pellicularia salmonicolor* (B. and Br.) comb. nov.

My grateful thanks are due to my colleague, Dr. Mundkur, for not only giving the advantage of his vast knowledge of taxonomy but also for permitting me the use of his collection of books and periodicals; and to Rev. H. Santapau of St. Xavier's College, Bombay, for translating in Latin the diagnosis of *P. alba*.

Imperial Agri. Res. Institute,
New Delhi, J. F. DASTUR.
June 26, 1946.

1. Dastur, J. F., *Ind. Jour. Agr. Sc.*, 1940, **10**, 89-92. 2. — *Ibid.*, 1941, **11**, 892-901. 3. Mundkur, B. B., *Curr. Sci.*, 1940, **9**, 284. 4. Rogers, D. P., *Univ. Iowa. St. N. H.*, 1935, **17**, 1 43. 5. —, *Farlowia*, 1943, **1**, 95-118.

AN UNUSUAL MODE OF EGG-LAYING IN *SCHISTOCERCA GREGARIA* FORSK. AND ITS CAUSES

INTRODUCTION

FOR the first time in 1941 Lal observed an unusual mode of egg-laying in *Schistocerca gregaria* Forsk. In this case the eggs were laid on the surface and on the leaves of the trees, though usually they are laid four to six inches below the surface. My idea is that the locust begin laying eggs on the surface when they are unable to retain them. After fertilisation or even without fertilisation a stage comes when they cannot retain the eggs, if they find suitable places they lay eggs in the usual manner, otherwise they drop their eggs here and there indiscriminately and thus simply get rid of them. To ascertain the above-mentioned view the following experiments were performed.

EXPERIMENTS

Experiment No. 1.—A number of newly emerged adults were collected from a swarm, cut of which 24 males and 24 females were selected for the experiment. In one cage 12 female locusts were kept, after some time they changed their colour from pink to yellow and later on laid the eggs. These eggs were laid in the usual manner, *i.e.*, after boring the holes in the moist sand which was kept in the cage. But none of those eggs developed further as no hoppers emerged. This shows that a time comes when a female locust cannot retain even unfertilised eggs.

Experiment No. 2.—In a cage a dozen locusts, *viz.*, six males and six females, were kept. These locusts after maturation copulated and laid eggs on the surface of the floor of the cage as there was no sand in the cage. These

eggs were laid indiscriminately on the surface. There was no egg-mass of more than six eggs. Some of these eggs were collected and were kept in moist sand, and they showed further development in the usual manner. But those eggs, which were left in the cage, died. This shows that after fertilisation there comes a time when the fertilised locusts cannot retain the eggs, they must lay whether the conditions for oviposition are suitable or not.

Experiment No. 3.—In a cage six pairs of locusts were kept; after maturation and copulation, the eggs were laid in the usual manner in the moist sand which was kept in the cage.

Experiment No. 4.—In a cage six pairs of locusts were kept, after maturation and copulation, the oviposition took place in the cage where there was only dry sand. After copulation the females began boring the sand but after each boring they used to leave the bore without laying eggs in it. Each female tried a number of times, when they did not find the conditions suitable they waited for two days more but later on they laid eggs on the surface of the sand.

Results

In all the four experiments the conditions were more or less similar. Where there was no moist sand the same humidity was maintained otherwise, the temperature was also more or less the same. All the locusts were given similar food. But the results were different. The egg-laying began first in the third cage, *i.e.*, where the conditions were absolutely normal, but the egg-laying was delayed by two days in the second and the fourth cage, *i.e.*, in the cages where conditions were not normal, *viz.*, either there was no sand or there was only dry sand. The egg-laying was further delayed by two days, *i.e.*, by four days as compared with the first case, in the case of unfertilised locusts. This shows that an unfertilised female can retain eggs for a longer period than a fertilised one. If the locusts do not find suitable places for egg-laying they can retain eggs for a longer period than those cases where they find suitable places, but later on they must lay eggs whether the place is suitable or not. If they do not find suitable place they leave the place after boring only without laying eggs in it.

The observations in the natural conditions also support the above-mentioned views. So far the unusual mode of egg-laying has been observed at only three places in India, *viz.*, in the eastern part of Jaipur State, Alwar State and the western part of the United Provinces. All these places are almost the extreme limits of the eastern part of the area upto which the oviposition generally takes place. When the swarms migrate from the north-west of India they are immature and fly eastwards. As they fly further and further they become matured, in the way they settle down and copulate, and if the place is suitable they lay eggs then and there, but if they do not find any suitable place in Sind, Jaisalmer State, Jodhpur State or even in the western part of Jaipur State they migrate further, by that time a stage is reached when they cannot retain the eggs any longer and therefore begin laying eggs whether the place is suitable or not. By that time they feel so uncomfortable that they want to get rid of their eggs, and thus they drop their eggs on the surface of the ground or on the leaves of the trees. It may be noted here that this phenomenon of unusual mode of egg-laying is generally observed in the beginning of the monsoon season when there are not sufficient rains in the Jaisalmer and Jodhpur States.

Summary and Conclusions

A time comes when the locusts are unable to retain eggs whether they are fertilised or not, in such cases they begin laying eggs on the surface indiscriminately, so as to get rid of their eggs, perhaps because they feel very uncomfortable.

At the time of egg-laying they bore in the ground, if there is no moisture they leave the bore without laying eggs in it, and lay the eggs on the surface.

Lal's contention is that the locusts do not bore the ground but lay eggs on the surface on account of the extreme dryness of the ground. But my observations show that the extreme dryness of the ground is not the only cause but their inability to retain the eggs inside forces them to lay the eggs anywhere indiscriminately.

Agricultural Research Labs.,
Gwalior, R. Rakshpal.
April 23, 1946.

1. Lal, K. B., *Indian J. Ent.*, 1941, **3**.

POST-EMBRYONIC DEVELOPMENT OF ANTENNA OF *BAGRADA PICTA* FAB.

Almost all the members of the family pentatomidæ (Hemiptera-Heteroptera) possess five-jointed antennæ; similarly *Bagrada picta* Fab. also has five-jointed antennæ in the adult stage. But during the nymphal stages the antennæ remain four-jointed. Each antenna is long, filamentous, mobile and filiform. All the segments of the antenna are provided with bristles except the scape.

Just after hatching the first nymph stage has the four-jointed antenna. The scape is the smallest and is about 0·075 mm. long. The pedicel is about 0·12 mm. long and is shorter than the other two segments of the flagellum —the penultimate and ultimate, the latter is longer than the former and they are about 0·20 mm. and 0·23 mm. long respectively. Thus at this stage the arrangement of the antennal segments is such that the proximal segment is smallest and they elongate as the distal end is approached.

After the first moult the antenna becomes elongated but remains four-jointed. The scape remains smallest and is about 0·1 mm. long, while the pedicel elongates, becomes more or less equal to the penultimate segment but smaller than the ultimate and is about 0·22 mm. long. The penultimate and ultimate segments of the antenna also increase in length and are about 0·25 mm. and 0·37 mm. long respectively. The arrangement of the antennal segments remain more or less the same as in the first stage.

In the third stage nymph the antenna is still four-jointed. The scape remains the smallest and is about 0·12 mm. long. The pedicel grows further, becomes longer than the penultimate segment but remains smaller than the ultimate and they are about 0·4 mm., 0·3 mm. and 0·5 mm. long respectively.

In the fourth stage nymph the antenna continues to elongate but is still four-jointed. The scape remains smallest and is about 0·21 mm. long. The pedicel further elongates, becomes almost equal to the ultimate segment and is about 0·58 mm. long. The penultimate and ultimate segments grow further and are about 0·48 mm. and 0·6 mm. long respectively.

In the fifth stage nymph the antenna further elongates but remains four-jointed. The scape continues to remain smallest and is about 0·22 mm. long. The pedicel increases in length so much that it becomes the longest segment of the antenna and is about 0·85 mm. long. The ultimate segment is longer than the penultimate and they are about 0·72 mm. and 0·65 mm. long respectively. It may be noted here that the pedicel, which was the next smallest segment of the antenna in the first nymph stage, now becomes the longest segment.

In the adult stage the antenna, which remained four-jointed throughout the nymphal stages, now becomes five-jointed. The scape is the smallest and is about 0·22 mm. long. The pedicel is about 0·67 mm. long. The newly appeared third segment is about 0·47 mm. long. It appears that the pedicel has been divided into two segments and thus the antenna becomes five-jointed. The penultimate and ultimate segments are about 0·65 mm. and 0·67 mm. long respectively.

Conclusion

It has been shown that during the nymphal stages the pedicel continues to elongate much more rapidly than other segments of the antenna, but in the adult stage it becomes shortened, while other segments continue to elongate as in the previous stages. The natural inference would be that the pedicel becomes divided into two segments and thus becomes shortened. In fact it actually happens, *viz.*, a new segment appears in the adult stage and thus the antenna becomes five-jointed which was so far four-jointed.

Table showing the length of the different segments of Antenna of Bagrada picta *Fab. during the nymph and adult stages*

Nymyh Stage	Length of scape	Length of pedicel		Length of penultimate	Length of ultimate	Total length	Remarks
1	0·075 mm.	0·12 mm.		0·20 mm.	0·23 mm.	0·62 mm.	4–jointed
2	0·1 ,,	0·22 ,,		0·25 ,,	0·37 ,,	0·94 ,	4 ,,
3	0·12 ,,	0·4 ,,		0·3 ,,	0·5 ,,	1·3 ,	4 ,,
4	0·21 ,,	0·58 ,,		0·48 ,,	0·6 ,,	1·87 ,,	4 ,,
5	0·22 ,,	0·85 ,,		0·65 ,,	0·72 ,,	2·44 ,,	4 ,,
6 *a*	0·22 ,,	0·67 ,,	0·47 mm	0·65 ,,	0·67 ,,	2·68 ,	4 ,,
6 *b*	0·37 ,,	0·48 ,,	0·54 ,,	0·65 ,,	0·77 ,,	3·01 ,,	4 ,,

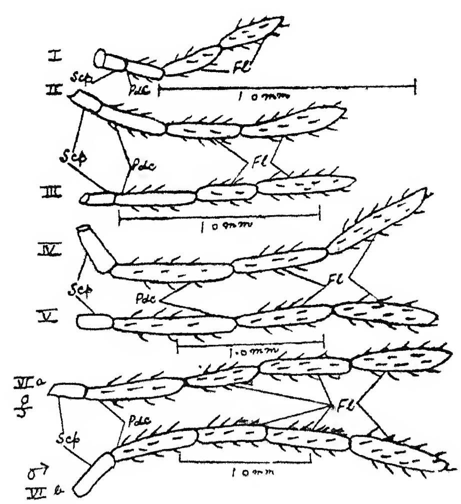

FIG. 1.—Antennæ of different nymphal stages of *Bagrada picta* Fab. I–V, Antennæ of nymphal stages ; VI *a*, Antenna of adult female ; VI *b*, Antenna of adult male ; *Fl.*, flagellum, *Pdc.*, pedicel ; *Scp.*, scape.

Hence it may be concluded that in *B. picta* Fab., it is the pedicel only which divides and thus a new segment is added to the antenna.

Now it can be generalised that wherever there is an increase in the antennal segment it is only the pedicel which divides.

I am very much thankful to Dr. R. Rakshpal, Entomologist, Agricultural Research Laboratories, Gwalior, for his kind help in connection with this work.

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June 6, 1946.

SHIVA SAHAI SAXENA.

PYTHIUM COLLAR-ROT OF FIELD PEA AT CAWNPORE, UNITED PROVINCES

No species of *Pythium* has so far been recorded from India or abroad except once by Wittmack[1] who found in the decaying roots of peas sent to him by Sadeback from Hamburg, Germany, oospores apparently belonging to a

new *Pythium*, which he called *P. Sadebeckianum.*

On 19th February 1946 the writer, while examining the pea-plots in the Research Farm, Cawnpore, observed a few scattered full-grown pea plants, presenting unhealthy appearance with most of their lower leaves yellowed out and dying; a condition unlike the effect of frost in which case leaves start dying from the top downwards. In some cases the pea plants had fruited. The examination of the collar of plants showed the presence of light-brown to dark-brown soft and water-soaked lesions. A large number of isolations were made and invariably in 90 per cent. cases a species of *Pythium* was obtained which readily formed fructifications (antheridia, oogonia and cospores) within a week on potato-dextrose agar at the room temperature ranging from 21° C. to 23° C. On 27th February 1946, the writer found in the dairy farm, Cawnpore, patches of diseased pea plants with pods in low-lying water-logged portions of the field. Here many of the pea plants were dead and some half dead; but all showed invariably the light-brown to dark-brown soft, water-soaked lesions on the collar. The same species of *Pythium* was isolated from a number of plants although in few cases (5 to 10 per cent.) a *Fusarium* sp. was also isolated. Preliminary pathogenicity experiments with pea seedlings in pots to establish the cause of the disease were carried out and it was found that pea seedlings (6-8 inches high) start dying with similar typical symptoms as observed in the field from fifth day onwards and by fourteen days all died, while controls remain unaffected. The room temperature ranged from 30° C. to 37° C. The fungus was reisolated from artificially inoculated dead pea plants. This species of *Pythium* forms zoosporangia and zoospores at the room temperature of 27° C. to 32° C. in light within 48 hours in distilled water. How zoospores emerge out from zoosporangia has not so far been observed. Further studies are continuing.

Plant Pathologist to
Government of U.P.,
Cawnpore, U. B. SINGH.
May 24, 1945.

*1. Wittmack, L. "Ueber Eine Durch pythium veranlasste Ekrankheit der Erbsenwurzeln," Paper presented at 64. Versamml. *Zu.* Halle, *Gesell. Deut. Naturf. u. Aerzte*, Sept. 1891. Not published. Title in Verhandlungen 2: 108, 1892.

N.B.—Since the writing of this note the writer has come across a record of pea blight probably caused by *Pythium debaryanum* by Jones. Jones, F. R. (1920) 'Pythium as a casual factor in 'Peablight'," *Phytopath.* **10**, 67.

EFFECT OF NA-SUPHAPYRIDINE ON THE CATALASE ACTIVITY OF RICE SEEDS

THE use of sulpha-drugs for the treatment of human diseases is well known and their action on the different physiological activities of the human body is under investigation by a number of workers. But the action of these synthetic drugs on plants has been little investigated. This note is the outcome of an attempt to study the effect of Na-sulphapyridine (M.B. 693—water-soluble) on the germination percentage and catalase activity of rice seeds.

Rice seeds of the variety D.1.4, supplied by the Cuttack Farm, were used in this work. For the germination study, 100 seeds were soaked in solutions of the different concentrations of the drug (1 per cent., ·1 per cent., ·01 per cent. and ·001 per cent.) and distilled water in petri-dishes. The dishes were kept in a moist chamber to guard against any rapid change in the concentration of the solutions. The solutions and the distilled water of the dishes were changed twice daily. For the determination of the catalase activity, the same arrangements were made except that 25 gms of the air-dry seeds were used instead of 100 seeds.

The germination counts were made in the afternoon daily, and the values are expressed on a percentage basis. For the determination of the catalase activity, 1 gm. of the soaked seeds was taken and was macerated with 3 gms. of calcium carbonate. The pulverising process continued up to 3 minutes and next the mass made to 20 c.c. by the addition of the distilled water. The catalase activity is represented by the amount of oxygen liberated in each case in an unit time of 5 minutes. The apparatus and the experimental details were the same as advocated by Davis[1] and Miller.[2] The results are presented in the table.

TABLE

Time		Treatments				
		Distilled water	Conc. of Na-Sulphapyridine			
			·001%	·01%	·1%	·1%
36 hours after soaking	Germination %	27	50	29	29	15
	Catalase activity	9·5	14·5	12·5	9·6	9·6
60 hours after soaking	Germination %	59	60	68	32	15
	Catalse activity	11·5	17·0	14·0	12·5	10·0
84 hours after soaking	Germination %	88	97	68	40	15
	Catalase activity	14·0	21·0	20·7	9·6	9·0
108 hours after soaking	Germination %	88	97	72	40	15
	Catalase activity	16·0	21·0	22·0	11·0	8·0

An analysis of the results indicate that the drug in weak concentration has a stimulating action on the germination percentage and cata-

lase activity but with the increase in the concentration, there is a marked retardation. The results are preliminary and hardly any general conclusions can be drawn. Investigation in this line is in progress.

The author is grateful to Dr. Mishra, Head of the Botany Department, for his keen interest and for the facilities provided.

Botany Laboratory,
Ravenshaw College, SHYAMANANDA PATTANAIK.
Cuttack,
May 5, 1946.

1. Davis, W. E., "The use of catalase as a means of determining the viability of seeds," *Proc. 18th Ann. Meeting Assoc. of Seed Analysts*, 1925, N. A 6–12. 2. Miller, E C., *Plant Physiology* (Second Edition, 1938), McGraw-Hill Book Company.

D.D.T. AND OX WARBLE CONTROL

BECAUSE of the acute derris shortage consequent upon the recent war, investigations were conducted to find a substitute to be used in ox warble control. In conformation with the usual practice, D.D.T. at concentrations of 0·5, 1·0 and 5·0 per cent. both in turpentine oil and in emulsion with kerosene oil and liquid soap, was sprayed on different batches of cattle during the warble-fly egg-laying season (March-June). These animals when examined for warble tumours during October to January showed infestation to the extent of 40 to 50 per cent. in each batch. This is about the normal percentage of infestation in the locality concerned. It would thus indicate that D.D.T. failed to act as an ovicide or a fly repellent for ox warble control.

Second attempt was made during the warble tumour season (October-January). D.D.T. in solution with turpentine oil at concentrations of 0·5, 1·0 and 5·0 per cent. was rubbed on full-grown warble tumours. Three days later the cattle were carefully inspected and none of the larvæ treated was killed.

Both these trials have conclusively shown that D.D.T. is ineffective against ox warbles. This unusual ineffectiveness of the drug could perhaps be attributed to the fact that D.D.T. being only a stomach and a contact poison for insects could neither bring about the desired effect to repel the adult warble-fly when used as a preventive nor could it kill the larvæ by acting as a respiratory poison when dressed over warble tumours.

Stewart (1944) while conducting experiments in U.S.A. for the control of ox warbles with D.D.T. has experienced similar results.

My grateful thanks are due to Dr. F. C. Minett for his advice and encouragement during the progress of this investigation.

This work has been carried out as a part of a scheme of research financed by the Imperial Council of Agricultural Research. The generosity of the Council is gratefully acknowledged.

Veterinary Zoology Section,
Imp. Vet. Research Institute, B. N. SONI.
Mukteswar (Kumaun),
March 15, 1946.

1. Stewart, M. A., *Jour. Econ. Ent.*, 1944, **37**, 756.

COLOUR DIMORPHISM IN *CERIOCOCCUS HIBISCI* GREEN

COMSTOCK discovered a new genus of wax-producing scale insects which he named *Cerococcus*. Green found a new insect which he classed under this genus and named it *Cerococcus hibisci*. This insect is also mentioned and illustrated by Ramakrishna Ayyar,[1] with Green's nomenclature, so that he naturally concurs with Green's classification. Ramakrishna Ayyar does not mention Green's *C. ornatus* which is commonly found in Bangalore. Upon the latter insect I have published[2] a short communication already. Both these species, *ornatus* and *hibisci*, do not secrete wax. On the contrary their scale consists of a leather-like product, insoluble in all fat solvents, quite unlike wax. Green kindly sent a specimen of an insect belonging to Comstock's genus, *Cerococcus*, which had genuine wax. A new genus has been already[2] created, *Coriococcus* which must now include *Coriococcus ornatus* and *C. hibisci*.

The wax-producing scale insects show the presence of yeast-like symbiotes. This is true of the genera *Ceroplastes*, *Ceroplastodes* and *Vinsonia*, which are all represented at Bangalore. The Chinese wax insect, *Ericerus pela*, which were examined histologically, also show yeasts. Unlike the above wax insects, *C. hibisci* and *C. ornatus* contain bacteria thus further differing from wax insects as a class.

Coricoccus hibisci has two forms, differing only in colour. In this respect it is similar to the lac insect of Kashmir, *Lakshadia ficii*, already illustrated[3] and *L. albizzine*, where also red and yellow forms are found. The one form of the *C. hibisci*, found on a wild plant of the genus Malvaceæ, at Bangalore, has the colour of burnt sienna. Its male is bright carmine coloured. The other form is greenish yellow, comparable with the yellow chrome as manufactured by Winsor and Newton. During the period of eight years at Bangalore only twice was the yellow form discovered on a weed of the genus Labiaceæ. The male is dirty brown, quite different in colour from the red male of the other form. Ramakrishna Ayyar mentions that *C. hibisci* "is popularly known as the yellow scale of the cotton as the scale have a pale yellow colour", without mentioning the existence of a reddish form. When he was the Government Entomologist here, Dr. B. P. Naidu, at my initiative, sent him yellow forms which he kindly identified as *C. hibisci*. Subsequently the reddish forms were submitted but so far has brought no reply; evidently he was unaware of the existence of colour dimorphism and did not risk identifying an insect unknown to him.

At Hyderabad, and in the city of Bombay, I have found this insect on *Hibiscus rosa sinensis*, most often as mixed colonies. In this city a pure colony of red forms was found only on a few occasions; far more common was the case with the pure yellow form.

It would appear that the red form is the original wild form from which a yellow mutant has arisen as a result of facilities in propagation. In the mixed colonies the red form is usually the more predominant but on

rare occasions the opposite has also been found. It is still unsolved if the red and yellow insect revert each to its opposite form. Experiments were carried out with the Kashmir lac insect which went to indicate such a transformation. Breeding experiments with pure and mixed brood have established that the progeny keeps true to the parents for one generation and under ordinary condition, but that physiological transformation of colour takes place must be self-evident.

The symbiotic bacterium of *C. ornatus* in culture produces a pale blue colour which changed to a bright red pigment as the culture becomes old; the skin of the insect is pale blue while its scale is red. It appears that the bacterium produces these two pigments, the red being formed as oxidation proceeds. With *C. hibisci* the symbiotes of both the forms microscopically appear identical. At Bangalore, where the yellow form of *C. hibisci* was not available, I had to content myself with studies on its red form. Its bacterium in fresh culture produces a yellow colour which darkens to burnt sienna, identical with the colour of the scale. In the case of the yellow and red lac insects none of them have any chromogenic symbiotes and it appears that the insects synthesise the dyes from products elaborated by the yeast-like symbiote. With *C. hibisci* either the yellow insect has a bacterium which is physiologically different or more likely the insect body prevents any further oxidation of the yellow pigment. It is proposed to isolate the bacterium of the yellow form which will throw light on the above problem.

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June 25, 1946.

1. "South Indian Coccidæ," *Imp. Inst. of Agri. Res. Btn.*, 1929, 197. 2. *C. R. Acad. Sci., Paris.*, **196**, 560. 3. *Archiv. J. Protist.*, 1929, **68**, Plate 17, Fig. 3.

NUCLEAR REORGANIZATION IN *EPISTYLIS*

DILLER[1] first announunced in *Paramœcium aurelia* the occurrence of a "purely asexual reorganization process" in which only the macronucleus was involved. He later[2] extended his observations and established that in this ciliate, in addition to conjugation and autogamy, a periodical change occurred in the macro-nucleus resulting in the extrusion of small bodies from it or in its total fragmentation. To this process he applied the term "Hemixis", and though its role in life-cycle, its relationship with conjugation and autogamy and its genetic effects are still to be studied, it was clear that hemixis occurred as a part of the normal life-cycle of the organism. So far this interesting phenomenon has been described only in *Paramœcium*.

It was, therefore, a matter of considerable interest to come across this process in another ciliate *Epistylis* (*Peritricha*: *Epistylidæ*). While investigating the cytology of 3 species of this genus, *E. plicatilis*, *E. anastatica* and *E. articulata*, it was discovered that hemixis was a very common phenomenon in all the species. All the three types of hemixis described by Diller[2] in *Paramœcium aurelia* were noticed: (*a*) extrusion of small spherical fragments from the macronucleus, (*b*) splitting of the macronucleus into large independent portions, and (*c*) total fragmentation of the macronucleus. But by far the most common was the

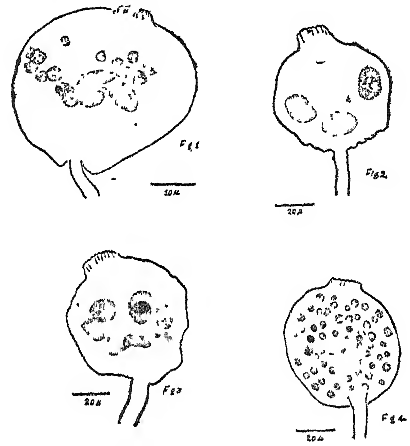

FIG. 1. *E. anastatica*, illustrating hemixis, type *a*; the macronucleus is extruding small spherical fragments.

FIGS. 2 and 3. *E. plicatilis*, illustrating hemixis, type *b*, in Fig. 2, the macronucleus has split into three fragments and in Fig. 3, it has split into seven fragments.

FIG. 4. *E. plicatilis*, illustrating hemixis, type *c*; the macronucleus has fragmented into numerous small bodies.

last type involving the fragmentation of the macronucleus into an incredibly large number of minute spherical bodies.*

The details of the process will be published elsewhere.

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July 6, 1946.

1. Diller, W. F., *Science*, 1934, **79**, 57. 2. —, *J. Morph*, 1936, **59**, 11.

* The author wishes to thank Mr. S. C. Pillai, Department of Biochemistry, Indian Institute of Science, Bangalore, for placing a large quantity of material at his disposal.

PEACEFUL V-2 ROCKETS

GERMAN V-2 rockets are being fired in New Mexico. Their warheads, which formerly contained the explosive charge, are now being equipped with apparatus for the measurement of cosmic-ray intensities at altitudes as high as 100 miles above sea-level.

B-29 bombers, also, are collaborating in cosmic-ray studies—flying at altitudes of 35,000 feet between the northern United States and the magnetic equator. The range in latitude is important because of the variation of cosmic-ray intensity with distance from the equator.

—Courtesy of *Sky and Telescope*, 1946, **5**, 10.

REVIEWS

Major Instruments of Science and Their Applications to Chemistry. (Inter-Science Publications, Inc., New York, N.Y.), 1945. Pp. 147. Price $3.50.

Amongst the outstanding developments in Physical Science, some of the most remarkable have originated in the interface, Physics/Chemistry. To the rapidly growing body of knowledge in this borderland, the present monograph is a valuable addition. Its various sections, contributed by specialists, refer to Electron Diffraction; X-Rays; and Chemical Spectroscopy, including especially the infrared. The fundamental theory, experimental technique and practical uses of each of these topics are explained with precision and lucidity. From its discovery as a universal particle to a knowledge of its wave nature, the electron has played a unique role; of interest, not only from the theoretical standpoint, but also for the practical applications. Compared with X-rays, the electrons have remarkably low penetrability, *viz.*, 500 Å and 2,000 Å for a gold and magnesium film respectively, for 50 kV electrons. An X-ray pattern is produced by the body of a block; that due to electrons reveals its surface structure. This provides a powerful means for a study of films too thin for spectroscopic analysis and in "microchemical" amounts; so called mono- and multilayers and catalyst surfaces. That, of the 700 recent publications over 300 are contributed by workers in industrial laboratories, in U.S.A., is significant.

The least distance, distinguishable optically, depends chiefly on the wave-length. This last, for the electrons for large enough working voltages, turns out to be 100,000 times smaller than that of the visible light, and leads to over 100-fold increase of useful magnification in the electron microscope. Its constructional details, optimum working conditions and some peculiar limitations of electron optics, *e.g.*, aberration, are set forth. In an electron microscope the image is produced not by absorption or refraction, but by scattering by atoms in the specimen. This is roughly proportional to its thickness and density. With 60 to 80 kV electrons, 0·5 micron would appear to be a limiting thickness for organic materials for obtaining the electron micrographs. Striking results are obtained with colloids; clay particles; metallic smokes; 'latent image' of the photographic plate; elementary fibres in plastics and rubber; soap films; bacteria and viruses; thus *e.g.*, the tobacco mosaic virus is found to be about 3,000 Å and 150 Å in diameter.

The section on X-rays deals with various methods of obtaining characteristic patterns; methods for the structure determination of not only crystals but of such systems as rubber, gelatin, gutta percha; alloys, eutectoides and solid solutions, with typical results for the influence of stretching and annealing. An account is given of methods for the determination of electron densities at various positions of a unit cell. The resulting contour maps, showing the projections of the atoms in the cell "are nearest approach to direct photography of atoms and molecules".

Despite well-known treatises on spectroscopy the last three sections are undoubtedly a welcome addition. Within a compass of 80 pages the authors have presented critically and markedly lucidly, fundamental concepts in the spectroscopic analysis; its wide range of uses and likely developments. The inclusion of a careful selection of numerous tables of standard data and description of procedures for precise evaluation of basic experimental quantities, such as, for example, the intensity of lines, makes this part of the book valuable alike to a research worker and one interested in spectroscopy as an aid to the chemical theory.

S. S. Joshi.

Spectacle Lenses. By P. Hariharan, Trivandrum. (1946.) Pp. 110. Price Rs. 10.

The major portion of the book under review is on the subject of spectacle lenses but the author quite naturally leads on, in the final chapter, to more advanced optical work such as magnifiers, eyepiece lenses, and small achromatic objectives. The author starts from very elementary considerations both as regards the theory and the practice of manufacture of spectacle lenses purely by hand work. He ultimately ends with the making of these spectacle lenses by machine work, and in batches, comprising considerable numbers going under the name of the 'block system'. The design of the machines used in the manufacture of these spectacle lenses, is such that they can not only be fabricated from local materials with the craftsmanship available, but also could be later used for more advanced optical work. Special mention should be made of Chapter VIII on "Simple Devices to Help Production", where the usual standard designs are cleverly modified for home production. In the concluding chapter on "Advanced Optical Work", the author indicates in a general way the methods followed in the manufacture of telescope objectives, both reflectors and refractors, and also of precision optical flats that are used for testing purposes in the optical workshop and laboratory. Complete details of computation and manufacture are, however, proposed to be dealt with in another monograph on the subject.

A serious handicap to the development of the optical industry is the lack of glass of optical quality and also the availability of suitable abrasives. The latter disadvantage is not, however, so great since there are many naturally occurring abrasives, such as those mentioned by the author, and the industrial abrasives like carborundum can be manufactured in this country. Regarding optical glass the technical knowledge and experience required in its manufacture, and the financial commitments involved are very great.

The contents of the above book formed the subject of a thesis that was awarded the H. H. the Maharani Setu Parvati Bayi Prize for 1944, by the Travancore Government. The young author, who is the son of Dr. H. Parameswaran, Director of Industries in Travancore, and a pioneer in this country in the working of optical glass parts, deserves to be warmly congratulated for the commendable way in which he has got up his thesis into book form with appropriate line-drawings and halftone blocks.

R. M. Row.

Chemical Indusrty in India. A.I.M.O. Monograph No. 7. Bombay, 1945. Price Rs. 5-12.

The trend towards economic self-sufficiency has grown with increasing pace, and in this economy of every country, chemical industries occupy a unique position. It is, therefore, but opportune that the All-India Manufacturers' Organization should have, with considerable effort collected and published statistical and other informations to the extent available, regarding chemical industries in India.

This Monograph of 250 pages, consists essentially of five chapters on general surveys covering 80 pages, while the rest of the book is devoted to various tabulated details regarding distribution of chemical establishments in India, trade statistics, and a bibliography of technical publications. In Chapter II, there is a survey of the development of chemical manufactures in India, and the contributions to the same by the opportunities provided by the war. Chapter V, on "Notes on Chemicals", deals with specific essential chemical industries like the manufacture of sulphuric acid, soda ash, caustic soda, fertilisers, dyestuffs, etc., and gives concise notes on their present position and future possibilities.

This Monograph should prove to be quite a useful book of reference to all interested in chemical industries. However, Appendix I on the Chemical Establishments in India, would have been more useful and less misleading if care had been exercised in selecting the addresses for inclusion in the list. Besides prominent omissions, there are addresses which tend to give a wrong impression of the development of chemical industries in the area. The other Appendices on Exports and Imports are very informative.

M. A. G.

Trees in Britain. By L. J. F. Brimble. (Macmillan and Company, Limited, London), 1946. Pp. x + 352. 15*sh.* net.

Those who are acquainted with the author's book on *Flowers in Britain* would find in the present work a companion volume to it. Some of the trees dealt with in greater detail in the present volume were briefly described in the book on flowers. Many of the trees now described could not have found a place in the volume on flowers. In view of the importance of trees, the necessity for a separate volume on trees cannot, therefore, be considered as superfluous. The present volume on trees fills up a gap which would otherwise have remained unfilled.

The scope, arrangement and the presentation of the subject-matter of the book are on lines similar to those found in the author's companion volume on flowers. The author has written the book on trees as he did the one on flowers, not so much for the professional botanist, but more to cater to the interests of the much wider circle of readers represented by the laymen and plant lovers. Persons little acquainted with the science of botany would find it easy to understand the book as would those conversant with plant science. A perusal of the book would show that there is much more to learn about the trees than what is commonly known about them by those who are familiar with them.

The introductory part of the book is specially meant to help the reader to understand the basic principles underlying the broad groupings into which plants have been classified. The chapter on classification of plants explains in easy terms the principles of plant systematics. The author's advice that plants cannot be studied from books alone but that they must be studied in their habitat by rambling through woods and meadows is a very important one and cannot be over-emphasised. This should specially be borne in mind by all those who are concerned with the teaching of botany in schools and colleges.

The important trees of Britain belong to the cone-bearing and the seed-bearing types. The chief among these two groups such as the pines, firs, cedars, cypresses and the yews, the oak, birch, beech, willow, walnut and many others are all described not merely from the botanical or utilitarian point of view but also with reference to historical anecdotes or appropriate verses.

Although the book does not fully exhaust the list of trees of Britain, yet a great many of them have been well described. Considering the quick succession in which the two volumes on flowers and trees have been issued and the popularity which the volume on flowers has gained, it must be admitted that the average Westerner is a better lover of plants and greater appreciator of Nature's beauty than is his Indian confrère. The sense of appreciation of the beauty in Nature has to be cultivated in the people of this country and this can only be done if this sense is developed and trained in school children. Towards such an end books of the type written by Brimble on flowers and trees would be very helpful. The volume on *Flowers in Britain* and *Trees in Britain* should be included in the library of every school and college in this country.

The beautiful coloured plates, the photographs and the author's line-drawings—all contribute much to the value of the book. The get-up is attractive and would appeal to many. The book should become very popular.

L. S. S. Kumar.

The Tanner.—*A Monthly.* Edited by Sri. S. Raja, "Jer Mansion", Bandra, Bombay.

The tanning of leather which a decade ago was mainly an empirical trade has, in recent

years, grown into a highly specialised scientific industry. India has never in the past been able to keep pace with the rapid development of the scientific industries of Europe and America but a new era of industrial progress is approaching and as one of the largest producers of raw hides and skins in the world, India possesses unique opportunities for the scientific advancement of her Tanning Industry.

We, therefore, welcome with much pleasure, the advent of *The Tanner*, a Bombay Monthly, devoted to the tanning and allied trades. The Journal is edited by Mr. S. Raja who, with his large and varied experience of the industry, has excellent opportunities for helping its scientific development.

The initial issue of *The Tanner* mainly emphasises the "trade" aspect of the industry. Rightly or wrongly, the speedy advancement of any branch of scientific research seems to depend on the well-being of the "trade" to which it relates and it is, therefore, in the fitness of things that a trade journal like *The Tanner* should primarily cater to the "business" side of the industry.

The first issue reproduces two articles of particular importance to the Tanning Industry. Sir Ernest Bevin, in his article "Planned Stagnation", complains of the evils of bureaucratic interference with the normal functioning of business in England. Mr. Humayun Abdulali tells us of the bungling of the Government of India in respect of India's raw hide trade during the period of war. It is characteristic of Governmental attitude that the Director of Tanning and Footwear, who must be held primarily responsible for the raw hide muddle, seeks to shift the blame on to the members of the Tanning Industry for their want of mutual co-operation!

All these post-mortem wails of wrongs done and evils established might have been avoided if opportunities for timely criticism had been freely available to all the members of the trade through the medium of a recognised trade journal. Luckily we have at last finished with the vagaries of war-time "Controllers" and "Directors" but even in a Free India the *"Pundits"* of post-war planning may, in all good faith, place hurdles in the path of progress unless every view-point is openly discussed and unbiassed decisions arrived at. It is in this respect that a trade journal can best serve the interests it represents and we wish *The Tanner* a long life of service in the cause of the Indian Tanning Industry. .

G. R.

Melanchthon—Alien or Ally? By Franz Hildebrandt. (University Press, Cambridge), 1946. Pp. 98. 8*sh*. 6*d*. net.

While the whole civilized world to-day is profoundly preoccupied with the task of unravelling the mysteries of the Atomic bomb, a single and solitary use of which suddenly and precipitately brought about the end of Japanese sovereignty, it must be deeply interesting and intriguing to note that scholars and thinkers like Dr. Hildebrandt, "pastor and lecturer in Cambridge", should be found engaged in a discussion of theological problems relating to the spiritual friendship between Luther and Melanchthon which at first sight must seem removed far from the scientific pursuits grounded on laboratory methodology and verification, and *pro tanto* unprofitable and valueless. Be that as it may, the volume under notice makes a distinctive and striking contribution to a clear understanding of certain aspects, doctrines, and settings relating to the general dogmatics of Christian Theology and the dynamics of modern missionary endeavour. In the course of a brief "Introduction", the author indicates the nature of the relation between Luther and Melanchthon and the general plan of the book and the arrangement. It is observed that *Melanchthon* is "but a case", "not the original", and would be treated "both as a subject and as object of our inquiry" (p. xiii). In the "Prelude", certain resemblances and contrasts between the personalities of Luther and Melanchthon are emphasized. In the first chapter Melanchthon's "Concessions to Tradition" are examined. The second is devoted to a discussion of "Concessions to Reason". The third deals with "Concessions to Law". The fourth examines the nature of "Concessions to Power", and the fifth (final) chapter contains an attempt at assessment of the value of nature and extent of "Concessions to Opposition". The territorial boundaries of "Adiaphora" and "Diaphora" are marked as it were and their limits discussed.

From the forementioned necessarily brief summary of the main contents of the volume it must be obvious that Dr. Hildebrandt has a complete and disciplined control over the Luther-Melanchthon literature, and he has brought out with striking clarity and balance of critical judgment the fact that in all respects in which Melanchthon felt obliged to strike a departure from Luther, the basic and fundamental determinant of such a departure should be deemed the pointed and definite leaning which Melanchthon felt for humanism the heritage of the hey-day of hellenic civilization. The different details in respect of which the rigour of the reformation of Luther had been toned down by the humanistic leanings of Melanchthon would bring home the truth that Melanchthon has to be regarded as an "ally" (simple, rational answer to the query posed as the title of the volume). "Current Science" in the sense of qualitative and quantitative laboratory analysis of phenomena would never have a warm corner for such theological discussions, and it is noteworthy that it is well nigh impossible to reconcile the modern doctrine of Evolution with the accounts of creation contained in the scriptures of the world, and conversely, such accounts with the scientific doctrine. The subject-matter and methodology of Theology would never admit of scientific verification (proof or disproof).

Going through Dr. Hildebrandt's discussions, one would easily realize that the controversies centering round biblical dogmatics and exegetics have their prominent counterparts in other systems of thoughts as well, say, for instance, the *Vedanta*, grounded on scripture *Sruti—Sastra*. The Christian theologian cannot with any sense of fairness or justification cast any

critical stones at the *Vedanta* and condemn it on account of its allegiance to scripture. Let this pass. In the chapter on "Concessions to Reason", it is stated: "Either he is saved by God's grace alone, or he is lost through his own fault—we must leave it at that ...." (p. 22). I am afraid it cannot be left at that. Man's fault cannot annul or cancel the saving grace of the Lord. Even those who declare acting under some abnormal or morbid urge for the nonce, "Evil be thou my good" must have a chance to save themselves. God's saving grace, however, must never be contingent, in fact it cannot be, on any denominational loyalty or allegiance to Christianity or the *Vedanta*.

The entire trouble is this. The grace of God cannot arbitrarily descend on this or that individual or community, and it appears reasonable to postulate that one should secure the necessary eligibility to become fit receptacle or recipient of God's grace. Unique in the history of human speculation, standing almost in a *sui generis* category, there is the planned program of psycho-physical or psycho-somatic purification outlined by the *Yoga-Darsana* which is intended to enable aspirants and devotees to make themselves eligible to receive divine grace. The system, its concepts, methods, and claims have yet to be studied under the controlled conditions contemplated by modern Experimental Psychology or Pure Psychology or Para-psychology, and whether the structural and functional changes effected by the practice of the *Yogic*-discipline can be demonstrated in a fool-proof manner is still an open question. I mention this just to illustrate that Christian Theism has to take its place side by side with other Theisms, share their vicissitudes, excogitate their problems and difficulties, and no philosophical specialties and theological reservations or even safeguards can be claimed on its behalf.

On page 98, Dr. Hildebrandt speaks of disharmony in Melanchthon between "concessions" and "confessions" and remarks that such is the fate of all who happen to be children both of Reformation and Humanism. But, then, there are very obvious limits to the concessions that can be legitimately made be it to Science or to Religion. Thus, there cannot be any concession at this distance of time as between the geocentric and the heliocentric world-views. One of them must be rejected as totally untenable. Likewise the scientist cannot be permitted to go on dogmatising adversely on the data of religion and philosophy simply because, they lie beyond the control and jurisdiction of laboratory methodology. It would be interesting endlessly to speculate. If Malenchthon had not administered a humanistic orientation or re-orientation to Luther's Reformation, would it have made a compelling dynamic appeal to the *intelligentia*, and the people at large? Taking a detached view, I feel, after a fairly careful study of Dr. Hildebrandt's illuminating analysis that the philosophical and theological excellences of the teachings and doctrines of Luther appear more alluring and inviting after the humanistic re-orientation administered to them by Melanchthon. Students of comparative religion and thelogy would unhesitatingly felicitate Dr. Hildebrandt on his analytical and arresting discussion of the relation between Luther and Melanchthon.

Madras, R. NAGA RAJA SARMA.
May 19, 1946.

Maya.—Its Spiritual Exposition based on the Theory of Relativity. By Swami Madhav Tirtha. (Gnana Sadhana Ashrama, Chhota Udaipur, East Guzerat.) Pp. 107. Price Re. 1-0-0.

The relation between strict Laboratory Sciences on the one hand and Religion and Philosophy on the other has been a permanent and persistent problem, and with the fabulous and phenomenal advancement effected by modern sciences, the spectacle of Religion and Philosophy coquetting with the methods and conclusions of the scientific disciplines has been fairly frequent and insistently amusing. On the contrary, certain scientists have also not been wanting who have been reciprocating the coquettish contacts and advances with the result that a terrible type of hybridisation or cross-fertilisation has been irresponsibly effected, pointing to scientifico-metaphysical miscegenation. Swami Madhav Tirtha's undoubtedly brilliant volume under notice seems to me to be a striking instance of such a miscegenation. I wish it clearly to be understood that Swamiji's present effort is highly commendable and praiseworthy, but, after a careful study of the work the conclusion seems irresistible that Einstein's Theory of Relativity has no philosophical relation or intimacy with the doctrine of *Maya* as expounded and elaborated by masterminds and mastercraftsmen like Sankara in the course of the steady, systematic and progressive development of Indian metaphysical speculation. It will surely not be out of place, briefly to recall that Einstein formulated his Theory of Relativity in order to account of certain observed anomalies of movements in respect of the perihelion of Mercury and the General Theory and Special Theory, its vindications, repudiations and countless other vicissitudes have all been before the world of scholars now for a considerable time. Lord Haldane in his *Reign of Relativity* has worked out the philosophical implications of the theory in all its details and uncanny ramifications. It would be a mistake to suppose that the Theory of Relativity has been universally acclaimed and accepted without a murmur, or a challenge. Many of your readers will easily recall Shaw Suleiman's searching criticisms of Einstein. "The Case Against Einstein" is the arresting title of a well-known volume. It is against some such background as the above Swami Madhva Tirtha's attempted correlation between *Maya* and Relativity has to be examined.

In the course of his "Introduction", Swamiji observes that the doctrine of *Maya* which several find baffling, would considerably be simplified if *Maya* is understood as a "measure or a measuring instrument". The subsequent discussion stands arranged into *five* chapters,

each being devoted to a critical analysis and elucidation of a particular topic. Thus "Space", "Time", "Motion", "Causation", have a chapter each. In the fifth, Swamiji records in a striking and succinct manner "Philosophical observations" grounded on what he considers solid and substantial foundations of affinity between the theory of Relativity and the doctrine of *Maya*. Quoting from Eddington and others, Swamiji explains that the world as ordinary commonsense and science understand it seems "almost like a dream", "the mind makes the world", and so forth. It seems to me that in the interests of clarification of concepts and fixation of their legitimate conceptual boundaries, it must be pointed out that the General and Special Theory of Relativity as understood and elaborated in physics, pure and applied, in mathematics, pure and applied, and allied disciplines, has absolutely nothing in common with the doctrine of *Maya*, which is just the doctrine of illusionism formulated by the great Sankara on the twin-basis of scripture and reason. Philosophy in the distinctively Indian connotation of *Brahma-Jignyasa*, quest after the Ultimate Reality, neither gains anything nor loses anything from the Einsteinean Theory of Relativity. That changing co-ordinates of reference change the vision and view-point of the percipient of a particular spatio-temporal order of events or point-events throws no light whatever on the persistent issue in metaphysical speculation between *Idealism and Realism* or between *Illusionism* and *Realism*. That there exists a cosmic-order originating, growing, decaynig and perishing independently and irrespectively of knowing subjects endowed with different gradations of awareness of consciousness is the main thesis of *realism* which has not in any manner been dislodged from its position of metaphysical eminence and prestige by the Theory of Relativity.

Centuries ago, the relativity of time had been emphasised. An amusing attempt is made to correlate time as understood and felt here on this planet and time as felt and understood by the four-faced Brahma, the Creator. Students familiar with the doctrine of *Yugas* would know that corresponding to the millions of years that have now elapsed since the dawn of *Krita-Yuga*, the four-faced Brahma has been passing through forenoon just past eleven o'clock. He has just read his morning papers perhaps, and according to an almanac, Brahma has finished his oil-bath and is practising *pranayama*. This must illustrate relativity of time with a vengeance, but, it surely does not solve the problem whether this or that monad, or centre of awareness, or unit of experience has actually brought the world into existence at the moment of perception—whether *esse* is *percipi*. The Theory of Relativity has no useful contribution to make towards solution of the persistent issue or problem of philosophy—*Illusionism* vs. *Realism*.

That the attempted correlation between *Maya* and the Theory of Relativity paints a totally misleading picture would be manifest from the following thesis: "... there is no Reason for the Relative, no origin or cause of it, he has no purpose, and serves no end, and in no way does he increase the glory of the Absolute, since it is always the Absolute" (p. xi). If the Absolute is always the Absolute, sciences and humanities, history and progress, movement and evolution would all be the merest weariness of flesh, love's labour lost. Life has some meaning simply because, some entities *not* the Absolute are endeavouring for moral and spiritual perfection marking the nearest approach to the Absolute. I desire to comment on only one more statement of Swamiji. Swamiji observes: "Universal Relativity insists that motion of the source towards the observer is identical with motion of the observer towards the source. Therefore, whether God descends in the heart of the *Bhakta* or *Bhakta* ascends in the heart of God, the result is the same" (p. 55). There are here three distinct entities, namely, *motion, source,* and *observer*, and Relativity as interpreted by Einstein, and Swamiji does *not* mean that all the three are illusionistic appearances of one and the same Reality whatever it is. Nor can the result be the same when God descends and when the *Bhakta* ascends. If, in terms of religious and spiritual currency, ascent and descent signify the same result, such a movement must be pronounced sheer waste. It is neither scientific nor philosophical just to dogmatise that *somehow there is movement*, and that the "why" and "how" of it all can never be understood by the relativity-ridden intellect of mankind. When Swamiji compares the "*Swarup* of Sri Krishna" to "the gravitational field", I am powerfully reminded of a like comparison and explanation of the Gopi-Krishna dance (*Rasa-leela*) as a dance of electrons round a central nucleus and so forth. *Obiter dicta* like "... disturbance in the gravitational field is matter". "Matter is a symptom", "Causation is relative" do not throw any light of the nature of matter at all. The series of dazzling successful achievements of modern science beginning from the primitive locomotive and progressing through the Atomic-bomb to more astonishing and flabbergasting discoveries must be understood as strictly grounded on the deterministic postulate of Cause-and-Effect which certainly is not written off by the Theory of Relativity. Lastly, the Swamiji is employing mystifying terminology when he writes that a man "can expand his space-time fully only by living for the whole of humanity—for the good of all God's creatures". For, such an expansion of space-time must be the merest pursuit of will-o-the-wisp on the strict logic of Relativity itself, as the co-ordinates of reference must go on endlessly varying, and as no two of God's creatures would agree as to what their God or *Good* would be unless they are compelled to submit to a economico-political order by some absolute dictatorship or democratised dictatorship. All this would transport relativity to mysticism. And when the Swamiji seriously tells us that in this relativity-ridden world, "God regards not the greatness of the work but, the love with which it is performed" (p. 95) God's weakness or strength in responding to such love must become an otiose concept in all relativity-based schemes. On the whole, Swamiji's work is illuminating and thought-provoking. Scientists and philosophers would find Swamiji's discussion arresting and entertaining. Proof-reading may have been done

relatively more carefully. Sanskrit terms are amusingly mis-spelt (p. 67).

Madras, R. NAGA RAJA SARMA.
May 21, 1946.

Modern Petrol Engines. By A. W. Judge. (Chapman & Hall, London), 1946. Pp. viii + 509. Price 36/- net.

There is much in common between this book and a book by the same author and publisher, issued in 1945, entitled *Aircraft Engines, Vol. I* —which was reviewed by Prof. R. G. Harris in *Current Science* for March 1946. The same review might be applied to the present book as far as general comments go. It is thoroughly up to date within the limits of permission to publish, it is well and profusely illustrated, it gives the main results of recent research with the aid of tables and graphs, and it is well indexed and referenced.

The treatment is descriptive rather than profused but it provides a good background for more thorough studies of the various principles enunciated and bare results of researches given.

The book suffers from the limitation that no examples for working are given and its value for teaching purposes is limited accordingly but it will appeal to a wide class of technical reader.

Although it overlaps the other book mentioned, it covers the wider range indicated by its title and contains more recent material concerning aircraft engines.

May 20, 1946. B. C. CARTER.

SCIENCE NOTES AND NEWS

Quartz Reef at Anappara, Cochin State.—A small quartz reef has been discovered just to the west of Anappara hillock near Trichur, Cochin State. It runs in a N.E.-S.W. direction and is highly fractured. The quartz is white and has a specific gravity of 2·77. A sample was analysed and was found to contain 98·9 per cent. silica. Pieces of magnetite are found here and there in the quartz reef, and, in one place, a few flakes of biotite were also observed. The Anappara hillock consists of gneissic rocks, and the gneiss has a specific gravity of 2·8. This rock is quarried in two or three places for use as building stone and road metal. The quartz reef occurs as an intrusion into the gneiss.

Pyrrhotite Veins at Irimpanam, Cochin State.—A few irregular veins of pyrrhotite have been discovered during the blasting of the charnockite rocks at Irimpanam near Tripunithura. This mineral is mangetic and has a bronze colour and metallic lustre. Its specific gravity is 4·73. The chemical analysis shows that it contains 63·75 per cent. iron and 36·24 per cent. sulphur.

The Wodjina Tantalite Deposits, Australia.—For years tantalum has been used in the manufacture of special non-corrosive steels, electrical apparatus, pen parts, watch springs and various precision instruments. It can be beaten into plates and sheets as thin as paper and is much more malleable than gold and silver. It is capable of being drawn into wires so fine that when they are used to sew wounds they leave no scar. Research has also shown that tantalum can be employed in making butadiene, special lens glass of aerial cameras and spinnerets for making rayons. Engineers need the metal for pumps, valve parts, carbide tools and temperature control instruments.

During the war, scientists found that this wonder metal possessed a number of properties which previously had not been known, particularly in the field of surgery. It could be used plastically to remove disfigurements, and as a substitute for bone. Ordinarily, living tissues keep away from foreign substances, but with tantalum this is not so. Flesh, blood and bones cling so closely to it that surgeons are beginning to think that the living tissue actually attaches itself to the metal.

Tantalum was needed for a good number of urgent war purposes. In 1942 the Australian Government took over the Wodjina fields, and installed machinery to increase production. So great was the urgency that at times cargoes of the ore were flown out in American service planes. When it was found that electronic tubes using tantalum were needed for Radar, the urgency became even greater. In peace, as in war, tantalum will remain one of the world's most precious metals. Because of that, Wodjina will continue to be one of the really important places in the world.

Modern Radio Technique.—The Cambridge University Press announces a new series of monographs dealing with the advances in radio techniques made during war time. It is well known that the important success of Radar in the hands of the Allies was due to rapid advances in the radio techniques involved, and in particular to the development of ultra-high-frequency radio. All the monographs included in the new series will be by authors who were personally responsible for important advances in the subjects they write about. Mr. J. A. Ratcliffe is the general editor. Nine such books are now in active preparation; of which two, *Radio Navigation Devices*, by Dr. R. A. Smith, and *Velocity Modulated Electron Tubes* by A. H. Beck, are complete and will go into production immediately.

Meteorological Office Colloquium, Poona.—Under the auspices of the above the following gentlemen spoke on subjects mentioned against each:—

24th May 1946, "Ice Accretion on Aircraft", MR. P. R. PISHAROTY.

30th May 1946, "Single Station Forecasting", F/O U. R. ACHARYA.

5th, 6th & 7th June, "Recent International and Empire Meteorological Conferences and the Meteorological Organisation in U.K. and U.S.A.", DR. S. K. BANERJI (*Director-General of Observatories*).

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CURRENT SCIENCE

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THE DIAMOND AND ITS TEACHINGS

THE INDIAN ACADEMY OF SCIENCES has once again made scientific history by the publication as its *Proceedings* for July 1946 of a symposium of original papers devoted exclusively to the physics of the diamond. Twenty-one memoirs by eight authors make up a volume of 197 pages illustrated by 23 full-page plates and numerous figures in the text. A similar symposium was issued in May 1944 which contained seventeen papers by eleven authors and ran to a total of 153 pages and 30 full-page plates. This was reviewed in *Current Science* for June 1944. Eight separate papers on diamond by various authors also appeared in the *Proceedings* during the latter half of 1944 and the first half of 1945. The enthusiasm manifested in this output of research possibly needs a few words of explanation. There is good reason to believe that the investigation of the structure and properties of diamond would lead to a deeper understanding of the basic principles of organic chemistry and of crystal chemistry. The crystal forms and the genesis of the diamond also offer problems of great interest to the mineralogist. And to the physicist interested in the theory of the solid state, diamond presents an almost illimitable field for fruitful research. For it is at once the most representative and the most exceptional of solids—representative because of its elementary nature and the simplicity of its structure, and exceptional because in spite of these qualities, it exhibits many remarkable properties and a fascinating variety of behaviour.

The principal difficulty in such studies is that of obtaining suitable material. Diamond shows wide variations in some of its most characteristic properties. Hence, the experimenter should have at his disposal a fairly large collection of specimens. This fact and the expensiveness of the best material is a discouragement to the investigator. The work pursued during the past few years at Bangalore has been made possible by the material gradually got together by the present writer. The additions made recently to the collection have been particularly useful and have enabled definite conclusions to be reached on many important questions.

The Crystal Forms of Diamond

Diamond presents some peculiar puzzles to the crystallographer. One of these is the strongly marked curvature of the faces of the crystals which is a very general feature, while in some specimens both plane and curved faces appear in combination. It is obvious that a crystal exhibiting curvature in some or all of its faces cannot appropriately be described in the usual terminology of geometric crystallography and that a new approach is therefore needed. In the introductory paper of the symposium, it is shown that the proper basis for description and classification of the forms is the pattern of sharply-defined edges seen dividing the curved surface of the diamond into distinct sections. These edges lie in the planes which contain the valence directions within the crystal taken two a time. There are six such planes and if they are drawn passing through a given point in space, their intersections with a closed surface surrounding it would divide up the surface into 24 triangular areas. In the ideal pattern thus derived, there are six points on the surface at each of which four edges meet and eight points where six edges meet. In a general way, these are the features actually seen on the surface of the diamonds, though there are certain modifications in detail. The configuration of the edges is found to be related in a remarkable way to the form of the diamond and the valence directions. The vertices or prominences of a crystal form are invariably points where four or six edges meet sharply. *Per contra,* on relatively flat areas of the surface, the edges are always inconspicuous and show a tendency to meander in their courses and to intersect in a somewhat haphazard fashion forming broken zig-zags. The form of the crystal approximates to a regular rhombic dodecahedron when all the prominent edges are nearly straight and parallel to the valence directions. Even in such cases, however, the rhombic faces are traversed by inconspicuous edges dividing them in two, thereby securing the usual subdivision of the surface into twenty-four distinct sections. This is an example of the general principle that the edges are most conspicuous when they nearly coincide with a valence direction and least conspicuous when they deviate largely from it.

The Crystal Symmetry of Diamond

The six planes containing the valence bonds are also the symmetry planes of the tetrahedral carbon atom. Octahedral symmetry for the crystal would demand three additional planes of symmetry, *viz.*, the axial planes of the cubic structure. If all these nine planes are drawn through a point in space, they would divide up an enclosing surface into forty-eight sections and not twenty-four. There is no hint or suggestion in the Panna diamonds of any edges lying in the axial planes of symmetry, and it may, therefore, reasonably be inferred that the crystal symmetry of those diamonds is that of the tetrahedral and not that of the octahedral class. The correctness of this inference is confirmed by the fact that the characteristic features of hemihedry are very clearly exhibited by numerous specimens. In particular, the configuration of the edges at the two ends of each triad axis of symmetry are found to be notably different, one end appearing as a sharp vertex or prominence of the crystal, while at the other end the surface is a flattened dome. Four different views of such a "tetrahedroid" diamond are shown in Fig. 1.

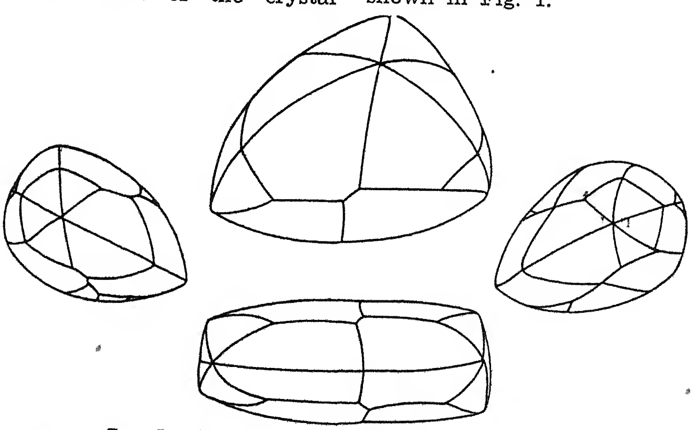

FIG. 1. Four Views of a Tetrahedroid Diamond.

It may seem surprising that diamond which consists of atoms all of the same kind has the same crystal symmetry as zinc blende which, as is well known, is a polar crystal exhibiting piezo-electric properties. This point is discussed in a paper by Mr. G. N. Ramachandran and it has shown that diamond may possess tetrahedral symmetry without being a polar crystal; a suitable distribution of the electron atmospheres would secure this result without involving any differences in the total charge attached to the individual atoms. It must not, however, be supposed that diamond is *invariably* a crystal of the tetrahedral class. The evidence of the crystal forms shows only that the majority of diamonds possess the lower symmetry and that diamonds which unambiguously exhibit the higher or octahedral symmetry are much less common. There is also distinct evidence from the crystal forms that the interpenetration of the positive and negative tetrahedral structures is a very frequent occurrence.

Atomic Vibration Spectrum

Being the typical valence crystal, diamond is particularly well-suited to be a test-case for theories of solid behaviour. In particular, its optical properties in the ultra-violet, visible and infra-red regions of the spectrum are of extra-ordinary interest in relation to such theories. It is not surprising, therefore, that these properties have come in for a good deal of attention. Indeed, the majority of the papers in the symposium are concerned with such questions. In particular, experimental evidence is presented in papers by Dr. R. S. Krishnan and Mr. K. G. Ramanathan which very definitely clears up the fundamental problem of the nature of the atomic vibration spectrum in a crystal lattice.

In principle, the problem of the vibration spectrum of a crystal lattice is a simple one. For, the structure of a crystal is three-dimensionally periodic in space and comes into coincidence with itself when given unit translations in turn along each of the three axes of the space-lattice. The characteristic modes of vibration of the atoms should accordingly also exhibit the same property. Since the phases of vibration of the atoms in a normal mode are either the same or opposite, the result of a unit translation would be that the phases of the atoms brought into coincidence either all remain the same or else are all reversed. We have thus $2 \times 2 \times 2$ or 8 distinct sets of cases to be considered. The set in which the phase of the vibration is the same in all the units of structure includes $(3p-3)$ modes of vibration (excluding simple translations), while the remaining sets give us $21p$ modes, p being the number of non-equivalent atoms per unit cell. Thus the result emerges that the crystal structure has $(24p-3)$ modes of normal vibration, each having a definite monochromatic frequency. These modes must of course be regarded as very highly degenerate, thereby taking account of the immense number of atoms whose vibrations they describe. The three modes left out in this enumeration represent the degrees of freedom carried over into the elastic or low-frequency spectrum of the vibrations of the solid regarded as a continuum.

The nature of the vibration-spectrum, as revealed by all the spectroscopic investigations on the scattering of light in crystals so far made, is seen to be in perfect agreement with the foregoing indications of the theory, provided the disturbing effect of the thermal agitation on the postulated regular ordering of the atoms is taken into account. The finite amplitudes of vibration and the resulting anharmonicity have also to be considered, as they give rise to the possibility of overtones and combinations of the $(24p-3)$ modes. What is needed for a complete demonstration of the theory is observational evidence that besides the $(3p-3)$ modes, the remaining $21p$ modes with sharply defined frequencies and their overtones and combinations also exist. Clear evidence on this point is furnished by the series of investigations recently carried out by Dr. R. S. Krishnan and published in the *Proceedings* of the Academy under the serial title of "Raman Spectra of the Second Order in Crystals". The results obtained by him with diamond are particularly significant and conclusive and will now be referred to.

Diamond contains two non-equivalent atoms in its unit cell, and hence the $(3p-3)$ modes give us three frequencies which reduce to one by reason of the cubic symmetry of the crystal. This is clearly the mode with the frequency of 1332 cm.$^{-1}$ revealed by the earlier studies. [One of the papers in the symposium gives accurate measurements of the frequency of this mode over a wide range of temperature and reveals both a diminution of

this frequency as also a steadily increasing width of the line with rising temperature. These data have also been discussed in relation to the thermal expansion of diamond for which a set of accurate data is presented.] The remaining eight modes are found to be inactive in light-scattering in agreement with theory, which, however, indicates that they may appear as overtones and combinations in the second order spectrum and this again is found to be the case (Fig. 2). The figure is a microphotogram and shows a series of well-defined peaks in the positions expected, a relatively feeble continuum overlying them, which evidently owes its origin to the numerous unresolved combinations of the discrete frequencies both amongst themselves and with the lower or continuous part of the vibration-spectrum of the lattice. Particularly noteworthy and significant is the fact that the peaks observed by Dr. R. S. Krishnan in the second-order spectrum of light-scattering agree closely in position with the series of sharply defined peaks observed earlier by Robertson, Fox and Martin in the infra-red absorption spectrum of diamond when examined under adequate resolving powers.

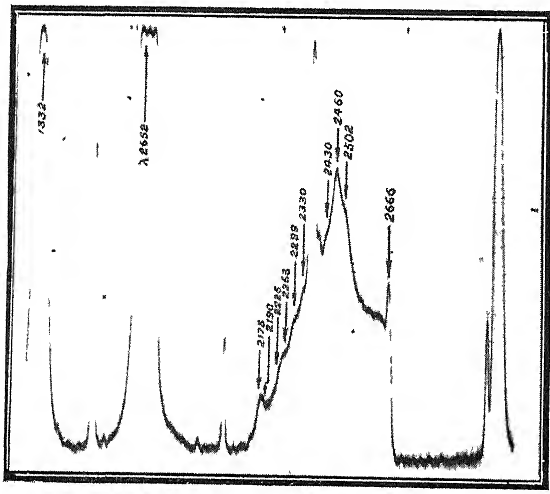

FIG. 2. Second Order Raman Spectrum of Diamond.

INFRA-RED ABSORPTION SPECTRUM

One of the most firmly established results of physics is the relationship between the various physical properties of a crystalline solid and the symmetry of its structure of which the external form of the crystal is an indication. The tetrahedral symmetry of diamond involves as a necessary consequence that the fundamental vibration-frequency of the lattice (1332 cm.$^{-1}$) should be active in infra-red absorption, while *per contra*, if diamond had an octahedral symmetry of structure, the same vibration would be inactive in such absorption. It had long been known that some diamonds exhibited an absorption-band in the 8 μ

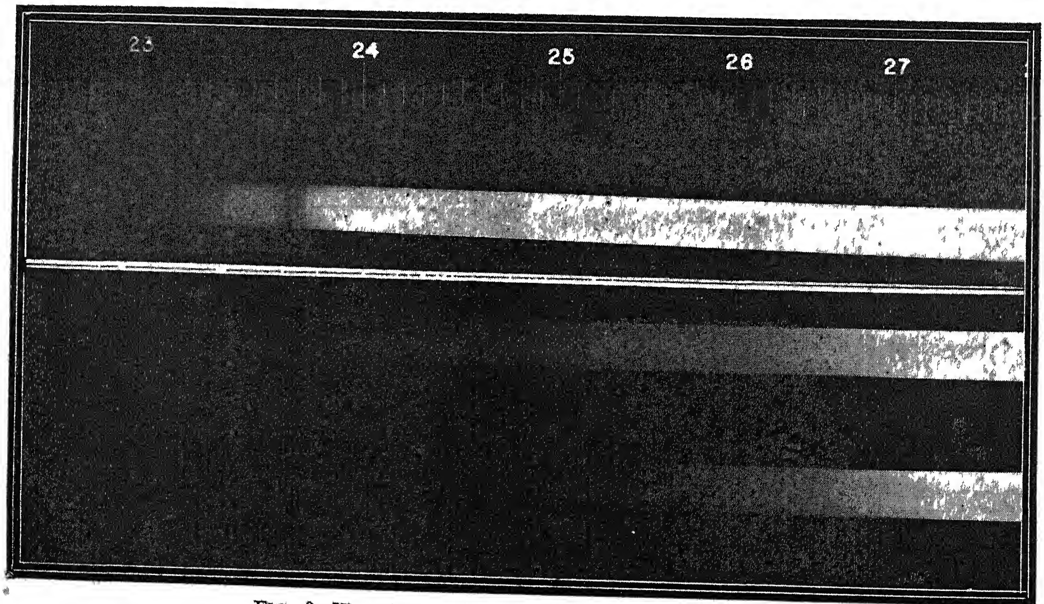

FIG. 3. Ultra-Violet Transparency of Thin Diamonds.

region, while others apparently did not, but evidently owing to the use of unsatisfactory material, the differences in behaviour hitherto recorded were not as clear as was to be expected, and the data also left much to be desired in other respects. In two papers appearing in the symposium, Mr. K. G. Ramanathan has cleared up the position fairly completely, both by obtaining and presenting new experimental data with numerous specimens of well-ascertained structure, and also by a detailed discussion of his results. As *Current Science* for July 1946 contained a report of his work, it is unnecessary to describe it in detail here. It will suffice to remark that his work settles a very important issue, *viz.*, the existence of allotropic modifications of diamond having tetrahedral and octahedral symmetry respectively and the activity of the frequency 1332 cm.$^{-1}$ in the former and its inactivity in the latter. Of particular importance also is the explanation put forward by him of the observed structure of the infra-red absorption bands in the 8 μ and 5 μ regions in the light of the theory of the vibrations of a crystal lattice discussed earlier. The demonstration of local variations in infra-red transparency over the area of cleavage plates of diamond is another noteworthy contribution made by this author.

The Electronic Spectrum of Diamond

That variations exist in the transparency of diamond in the ultra-violet region of the spectrum has long been known. A new complexion is given to the subject by the result established by Mr. K. G. Ramanathan that even the diamonds which in moderate thickness are opaque to radiations below λ 3000, are transparent upto λ 2250 provided their thickness is sufficiently reduced (Fig. 3).

Equally remarkable is the result established by the same author that diamonds of the same type if employed in sufficient thickness completely cut off all wave-lengths below about λ 4140 and also exhibit a whole series of discrete absorption lines and bands between this wave-length and λ 4800. New detail has also been recorded by him in the absorption-spectra of such diamonds right up to the limit of transmission, *viz.*, λ 2240, as observed at liquid air temperature.

From these studies, taken in conjunction with the results of the earlier investigations by Dr. P. G. N. Nayar, by Mrs. K. Sunanda Bai

FIG. 4. Birefringence patterns in Diamond.

and Miss Anna Mani, published in the *Proceedings* of the Academy, a very remarkable fact emerges, *viz.*, that diamond exhibits a whole series of sharply defined electronic frequencies in absorption between λ 2240 and λ 5359. Numerous sharply defined emission frequencies have also been recorded by Miss Mani in the luminescence spectra of diamond in the range between λ 4060 and λ6358, and in the majority of cases, corresponding absorption frequencies have been observed. The intensity with which these absorption and emission frequencies are recorded with different diamonds differ enormously. But there can be no doubt that they are all characteristic of diamond itself and that the variations arise from the same causes which give rise to the variations in infra-red absorption strength.

Allotropic Modifications of Diamond

It is a remarkable fact that though diamond is a cubic crystal it often exhibits birefringence, and that this not frequently takes the form of geometric patterns very clearly related to the crystal structure. Fig. 4 is an illustration of four large flat cleavage plates of diamond as viewed between crossed polaroids exhibiting this geometric character in a very striking fashion. These plates are all of the type of diamond which in moderate thicknesses is opaque to wave-length less than λ 3000. Diamond which is completely transparent up to λ 2250 invariably exhibits a characteristic and wholly different type of birefringence that is finely streaky in character. It must not be thought, however, that diamond is always birefringent. Indeed, this is not the case, and in the writer's collection there are several fine specimens of non-birefringent diamond, and these have been very successfully used by Mr. S. Ramaseshan for the studies of the Faraday effect in diamond described by him in the symposium. They belong to the tetrahedral or infra-red opaque type of diamond.

In the earlier symposium, the present writer suggested that birefringence in diamond—except when due to obvious cracks or other defects—arises from the juxtaposition in the same specimen of different allotropic modifications of diamond. This suggestion has been confirmed and placed on a quantitative basis by Mr. G. N. Ramachandran using a very ingenious method. The cleavage plate of diamond under examination is placed on the Federov stage of a petrographic microscope, using where necessary the auxiliary glass spheres. Very remarkable changes in the nature of the birefringence pattern are observed when the plate is tilted on the stage and also when the stage is rotated. A Babinet compensator inserted in the microscope so that the image of the diamond is focussed in its plane enables the sign and magnitude of the birefringence to be evaluated under these conditions.

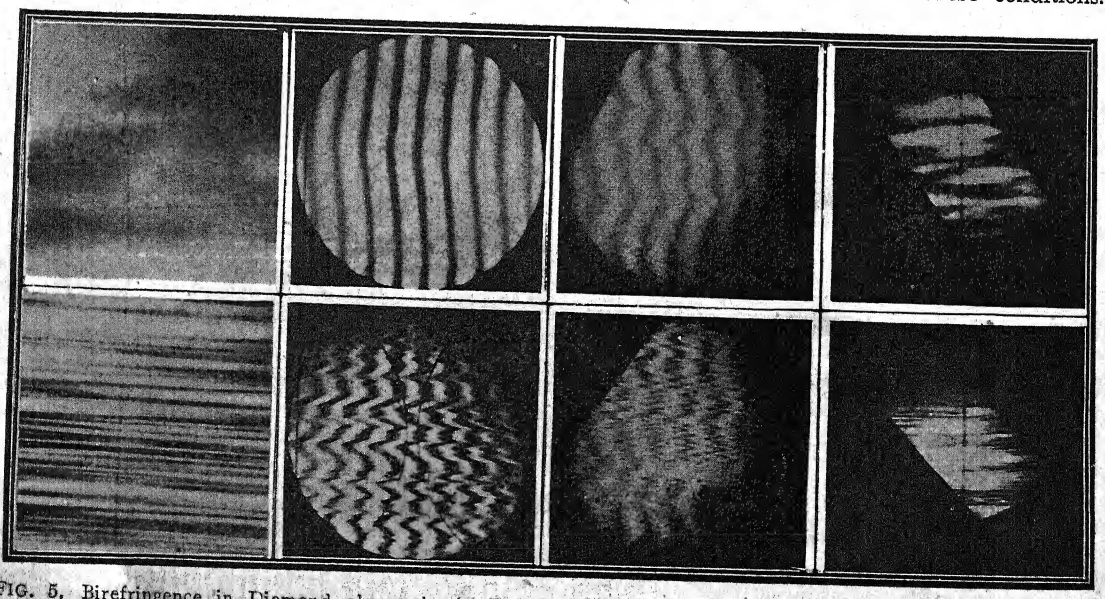

FIG. 5. Birefringence in Diamond observed with Federov Stage and Babinet Compensator (Octahedral Diamond)

In this way it has been shown that birefringence *invariably* arises from the presence of layers lying in the octahedral or dodecahedral planes and different from the material on either side. The upper and lower pictures in Fig. 5 represent the effects observed in this way of tilting the Federov stage with or without the Babinet compensator in the field. The diamond in this case was of the octahedral variety.

Fig. 6 shows similar pictures of a plate of tetrahedral diamond containing intruding octahedral layers. (The nature of the intrusion was verified in this case by the observation of the ultraviolet transparency of the layers). The picture shows that some of the layers have a greater and some a lesser refractive index than the rest of the diamond. These pictures clearly prove the existence of two forms of octahedral diamond, as had been suggested earlier by the present writer.

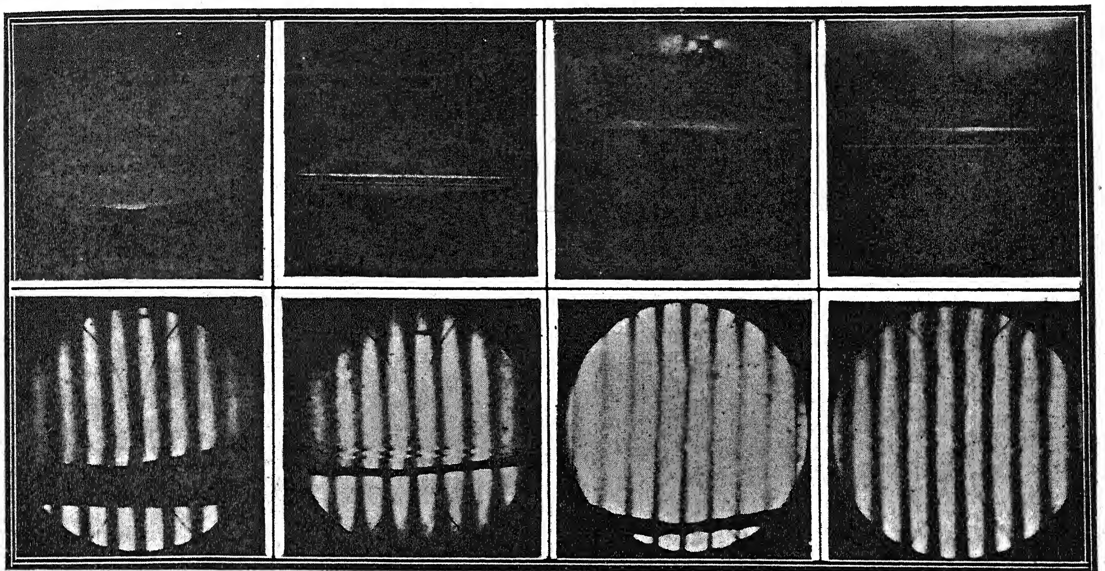

FIG. 6. Birefringence observed with Federov Stage and Babinet Compensator, showing intruding Octahedral layers in Tetrahedral Diamond.

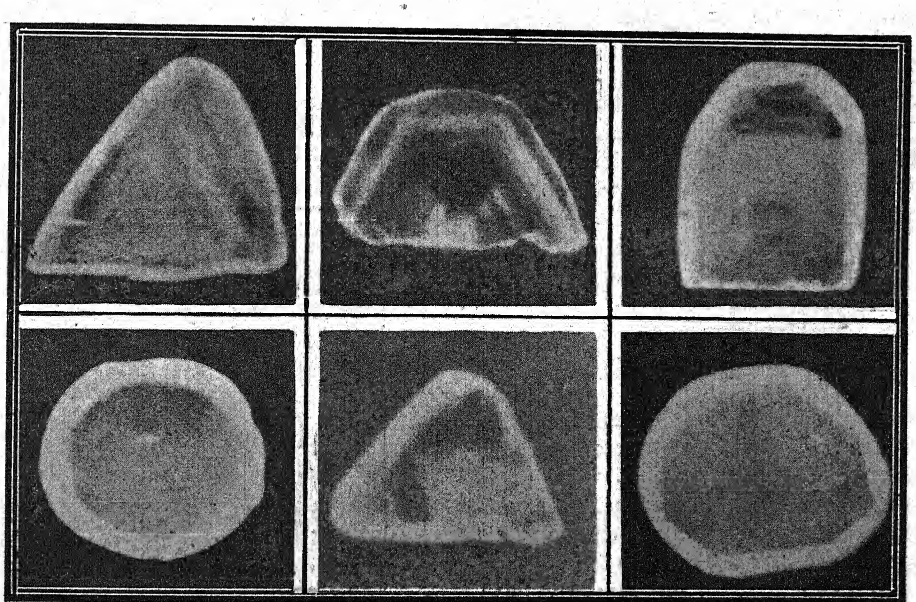

FIG. 7. X-ray Luminescence Patterns.

THE LUMINESCENCE OF DIAMOND

The fluorescence of diamond excited in various ways and the subsequent after-glow or phosphorescence form the subject of no less than six papers in the symposium which deal with these subjects from different points of view. Mr. G. N. Ramachandran has made a detailed study of the luminescence as excited by X-radiation, the mechanism of its production with special reference to the strength and quality of the X-radiation, and also the remarkable differences between such luminescence and that excited by ultra-violet light in respect of the spectral character of the emission and other features. With Mr. G. R. Rendall's paper are reproduced the luminescence patterns of no fewer than 19 cleavage plates, photographed separately to exhibit the "blue" and the "yellow" luminscence patterns. These are set alongside the ultra-violet transparency patterns and the birefringence patterns of the same diamonds, so as to exhibit the notable resemblances and differences between these patterns. Fig 8 is an example of such patterns, but the difference between the "blue" and "yellow" patterns and the analogy between the latter and the birefringence patterns are usually much more striking.

Mr. V. Chandrasekharan in one of his papers records a series of phosphorescence patterns obtained by the method of contact photography and shows that only the "blue" patterns as seen in fluorescence are recorded in phosphorescence, though the colour of the latter is "yellow" and not "blue". Mr. Chandrasekharan also describes a series of interesting studies on the activation of diamonds by short-wave ultra-violet rays and the release of such activation energy in the form of ""blue" luminescence by the impact of red light or other long-wave radiation or by the action of heat. These studies as well as the other papers noticed above demonstrate beyond all possibility of doubt that luminescence is a characteristic of diamond itself and not due to any extraneous impurities. Messrs. Ramachandran and Chandrasekharan have a joint paper, the results of which seem to indicate that the luminescence of diamond owes its origin to "forbidden" electronic transitions between various sharply defined energy levels characteristic of its crystal structure. That the intensity of luminescence varies enormously from specimen to specimen is not inconsistent with this view. This is indicated by the fact that increased

FIG. 8. Ultra-violet transparency, blue luminescence, yellow luminescence and birefringence patterns of a cleavage plate of diamond.

intensity of blue luminescence goes hand in hand with an increased mosaicity of crystal structure, as is shown in Mr. Ramachandran's paper on X-ray topographs. Local variations in mosaicity appear also to be responsible in some cases for the local variations in photo-conductivity discovered by Mr. Achyutan in the cleavage plates of diamond.

THE GENESIS OF THE DIAMOND

Reference should also be made to other papers by Mr. S. Ramaseshan appearing in the symposium. Besides being the joint author of the introductory paper of the symposium, he has developed the ideas contained in it further and put forward a definite theory of the crystal forms of diamond, connecting them with the circumstances of the genesis of the diamond and with the surface energy of the molten carbon from which the crystals formed. The calculations made of the surface energy of different crystallographic planes in this connection suggested that diamond should exhibit various other cleavages besides the well-known octahedral one. This prediction has been verified in experiment.

C. V. RAMAN.

INTERNATIONAL CONTROL OF ATOMIC ENERGY

Atomic Scientists Memorandum to U.N.O.

Summary of Recommendations

THIS summary is taken verbatim from the Atomic Scientists Association's memorandum, which makes the following recommendations:—

1. That an attempt be made immediately to obtain an international agreement by which the use of atomic energy, the distribution of the essential raw materials for it, and the erection and operation of plants designed to produce or capable of producing active materials would be strictly controlled by the United Nations Organisation.
2. That this control be implemented by a system of inspection which would give inspectors appointed on behalf of U.N.O. the right of access to any place, plant or institution in any country for the purpose of ascertaining that there exist no sources of supply, plants or installations for atomic energy, other than those approved by U.N.O.
3. That all major sources of raw materials and all major production plants be handed over to U.N.O. and be operated (possibly by national contractors) under international management boards responsible to U.N.O. and guarded by men also responsible to, and appointed by U.N.O.
4. The United Nations Atomic Energy Commission should undertake the construction and operation of new large-scale plant for the production of fissionable material. These plants should be so distributed throughout the world as to ensure that if any nation should seize control of the plants operating in the area in which its own armed forces are predominant the remainder of the United Nations would jointly possess an overwhelming superiority in the production of fissionable material.
5. That the disposal of active materials produced in such plants and the research, development, and production of atomic explosives be reserved to U.N.O. and that any bombs made in that way, or the bombs made prior to the operation of this scheme, be kept in stores distributed throughout the world and operated as described under (3).

This does not imply that the signatories regard the atomic bomb as a desirable or suitable weapon for carrying out the policing functions of the U.N.O. In the present state of world apprehension, however, it seems necessary that atomic bombs should be produced and controlled by an international authority, to prevent any ill-disposed nation holding the threat of atomic warfare over the peace-loving nations of the world. When, however, the control authority is functioning effectively, it should be possible to envisage the cessation of the production of atomic weapons and the destruction of existing stocks. Atomic explosives could then be used for peaceful purposes only.

6. That as the scheme described above becomes effective, the existing secrecy rules be lifted, starting forthwith with the release of all basic scientific information, and that eventually all research and development be carried on freely and openly, with a duty to report to U.N.O. any significant results, which will, in general, also be published.
7. That the free movement and interchange of all scientists, including those working on atomic energy, be permitted and encouraged to the fullest extent.
8. In the implementing of the above proposals we are impressed with the feasibility of the recommendation made in the Acheson Report of the division of atomic energy activities into 'safe' and 'dangerous' activities and consider that an approach of this kind gives promise of an effective control of atomic energy developments together with a minimum encroachment of the national sovereign rights of the nations.

—(Courtesy of *Discovery*, June 1946, p. 175).

THE BATTLE OF STEEL

THE Government Control of an industry has something in common with the imposition of income-tax. Individually we are apt to find both irksome but collectively as a nation we must admit that they both seem justified by necessity. *The Battle of Steel*, a well illustrated booklet, published by the British Iron and Steel Federation, tells in a simple fashion how the iron and steel industry of Britain was harnessed and regulated during the six long war years.

Section 1 of the booklet, "Steel at War", opens with the statement that the conclusion of the Japanese war has made it possible to tell this story. It is not a story of new tonnage records—in fact the tonnage produced in 1937 was never exceeded during the war. This is accounted for by the cutting off of four-fifths of the raw material normally imported, black-out difficulties, and the transfer from the industry to the military forces of many young workers.

It was fortunate that the setting up of the Iron and Steel Control was aided by the existence of peace-time organisations—for the meeting of war needs proved to be no mean task. Even so there was no finality as the war needs were constantly changing.

The overshadowing problem was the utilisation of the poor grade ores mined in Britain instead of the usual rich imported material. All the skill of the management, steel workers and metallurgists was required to meet this situation. Arrangements had to be made for the railways to transport immense quantities of low grade ore from the mines or quarries to the steel works and at times this ore traffic had to be weighed against the more immediate needs of war—for instance during the preparations for the invasion of Western Europe.

In Section 2, "Struggle for Raw Materials" the dramatic story is told of how five ships broke through the German blockade of the Baltic—to bring much needed cargoes of iron and steel from Sweden to Britain. A later attempt, although less successful, brought cargoes which averted "bottlenecks" in the tank and aircraft output. Not only was it necessary to adapt steel and iron works for the use of native high phosphorus ores but metallurgists had to devise new steels so as to economise alloying materials in short supply. A national survey of scrap resources was conducted at the height of the war and was followed by the collection of disused railways, bridges, tramlines and even railings around parks and houses. The German bombing of Great Britain provided an additional 600,000 tons of scrap—about half of which came from London. A brief reference is made to the negotiations with foreign powers for the supply of special materials such as chrome and tungsten.

Section 3, "Transport", relates that although the quantity of finished steel carried was not excessive—the haulage of large amounts of low grade ore over long distances was a major problem for the railways. Extra hopper wagons had to be built to handle this traffic.

The concentration of shipping at relatively few ports on the west of the U.K. accentuated these difficulties. Further, owing to the exigencies of war, ships sometimes arrived unexpectedly at unusual ports and the controller had to decide whether the cargoes could be utilised locally or had to be carried by rail to the original destination.

"Brick without Straw" is the caption of Section 4 in which the metallurgist "comes to his own". When the tungsten supply from Burma was cut off by the Japanese invasion—three new types of high speed steel—all using less of this precious alloying element—were evolved.

Economies were effected by using tools merely tipped with high speed steel, by ensuring that high speed steel was used only for work for which it was essential and by a propaganda campaign insisting on the proper care of tools.

Special arrangements had to be made to meet the heavy demands for accurately dimensioned high tensile steel components of Bailey bridges required for the armed forces. The heat-treatment of unprecedented quantities of armour plate necessitated the commandeering of many large furnaces previously used in the enamelling trade—and the equipping of these with suitable heavy charging gear. Perhaps the least spectacular but at the same time the most important achievement was the work of the Technical Advisory Committee in reducing the 2,000 odd steel specifications of the British Standard Institution to less than 90—which nevertheless covered all war requirements. An immense amount of invention and adaptation helped to meet these war-time demands. Much of the work is still secret and it is expected greatly to benefit the British steel industry in future.

Section 5, "The Human Factor", emphasises the chief difficulties that the management and labour had to surmount, namely, the black-out, loss of the younger men to the Forces and the radical changes in production practice due to the raw material position. In spite of all ventilation arrangements the black-out screens made conditions very difficult for workers in the steel melting shops. During Air-raids skeleton crews remained on duty and submitted themselves to additional hazards to ensure that the steel in the furnaces should not be spoilt. Women were employed in large numbers—sometimes in works where none was to be found before the war.

The last Section, No. 6, entitled "Mulberries and Houses", refers to the steel requirements of the great prefabricated harbour which was established on the Normandy beaches and which made possible the large-scale invasion of the "Continent". These demands had to be met without interrupting the supplies for other war requirements. Turning from war to peace—mention is made of investigations which have already been carried out in the construction of steel-framed dwelling houses and the Section closes with the statement that the British steel industry believes that in post-war years its contribution to the advancement of the peoples' material welfare must be as vital as the part it has taken in securing Britain's Survival against Axis aggression.

FRANK ADCOCK.

SIGNIFICANCE OF HUMAN INDIVIDUALITY IN WORLD AFFAIRS

BEYOND THE FOUR FREEDOMS: 'I' AND SCIENCE

By J. J ASANA

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OUR civilization, of which science is such a distinctive feature, seems to have lost its moorings. Few thoughtful people will dispute the statement that mankind to-day is not happy and the existing situation in world affairs is most distressing. How to remedy this intolerable state of things is a problem in which scientific workers, too, along with other people are now vitally interested, as at the root of this problem lie the questions of knowledge and value, what is the true and what should be the 'good' course of action.

One of the most comprehensive theories, proposed during the last World War, to meet this very difficult situation is the theory of the four freedoms for the common man. A concerted planning of the world's resources on a world-wide scale has been envisaged to work towards and realize these freedoms; and it is commonly believed that scientific discoveries and inventions will play a leading part in humanity's march towards that goal.

The writer is one of those who feel that something more is needed to diagnose and remedy the existing unhappy situation in world affairs. This theory of the four freedoms recognizes, implicitly or explicitly, the significance of man the individual and aims at an all-round welfare of the common man. It may perhaps be elaborated in the direction of gaining further intellectual clarification and conviction with a view to formulating an ultimate purpose in the government and civilization of men. This may perhaps help us to see in a more clear perspective the intellectual conflict regarding the significance and welfare of the individual *versus* those of the community or the state,—a conflict of ideas, ideals and modes of governmental action. which, as all thoughtful people see, is now gaining a world-wide stage and which may be a prelude to another world-wide conflict of arms. It may be that the canker, which is undermining and destroying our civilization, may have something to do with the problem whether mind has any existence whatever independently of matter, whether it is not a queer phenomenon not dependent upon matter altogether and seeking some freedom from the tyranny of physicalism.

It is conceivable that this more or less hidden intellectual conflict may partly be responsible in delaying the formulation and adoption of an idealistic, philosophico-religious outlook not only on life but in public affairs also for the realization of universal peace and goodwill among men, which scientific workers along with other people so earnestly desire.

In this article are offered, primarily for the consideration of students of science and scientific workers, a few comments and reflections on a more or less recent trend in scientific observations and scientific thought. This is done with a view to discussing whether the so-called 'mind' (the thinking-feeling-willing 'I'), is merely a functioning or behavciouring of a biological organism, such as a human being, as assumed by the majority of men of science; or does it give any scientifically collected evidence of being an agency, an entity, more or less independent of the biological organism.

If scientific workers at the present time do not see, logically or illogically, any purpose or human values in their study of nature, including the body of man, this discussion is also intended to make an appeal to them that a time has come in world affairs in which men of science should make an attempt to examine more thoroughly the relation of mind and matter, or 'physicalism'. Many of us feel that it has a direct bearing on some of the live issues of our day and is no longer a question of academic importance between science on one hand and philosophy and religion on the other. Some of us feel that in view of the present turmoil in state affairs these questions perhaps demand greater attention than the advancement of science itself, at least for the present. And though men of science are also idealists in their way, in the pursuit of what they call truth, it may be worthwhile to look for some evidence in scientific thought itself to encourage those of us who feel inclined to join forces with what is best in philosophy and religion for formulating a purpose for civilization and thus to work for a purposeful progress of science inspired by an idealistic view of life.

To avoid any misunderstanding of the writer's attitude towards the value of science to this country, he may be permitted to strike a personal note at this stage of the discussion. He yields to none in his enthusiasm and devotion to scientific studies. As a teacher in science, with some experience of scientific research and some familiarity with the literature on rationalism over the past several years, he has grown to be convinced of the immense value of science to India. It can confer incalculable benefits on our people. And he is fully aware that many superstitions, going under the name of religion, have been doing great harm as obstacles to this country's progress towards light and liberation.

IS THERE AN IRREPRESSIBLE, EVER-PRESENT 'I' IN MAN'S STUDY OF NATURE INCLUDING HIS BODY?

As all students of science know, many philosophers and religious-minded people for ages have been laying considerable emphasis on the significance of the human mind—the thinking-feeling-willing 'I'—in the study of nature and acquisition of knowledge. Men of science may have justifiably thought it expedient to put into background this wise admonition for some time. However, in view of the recent trend, described below, in different branches of science, it may be that the time has come for us, students of science, to give more attention

to the question of the relation of mind to matter, while not neglecting in any way our legitimate scientific studies.

PHYSICS AND 'I'

Scientific workers are familiar with recent advances in physics which lay considerable emphasis on the position of 'the observer', the human individual, in the study of the complex phenomenon of 'physicalism'. It is also well known that these remarkable researches have led many eminent physicists—Eddington, Jeans, Planck, Herbert Dingle and others—to make excursions into philosophy. Scientific workers with a philosophical bias may find recent communications of Professor Haldane and Professor Milne on "A Quantum Theory of the Origin of the Solar System" in *Nature*, No. 3927, February 3, 1945, highly suggestive. Professor Haldane suggests that the external source of energy postulated to make the sun emit the matter which condensed into the planets may have been a photon. In generating such a unique conception of photon, one wonders what part the phenomenon 'Haldane' plays.

EVOLUTIONARY BIOLOGY AND 'I'

The concept of the term 'progress' has been a matter of considerable controversy and is in fact the main thing at the back of the writer's mind in framing this article. In this connection it would be pertinent to our discussion to quote a few remarks of an eminent research worker in evolutionary biology, Professor Julian Huxley,[1] with regard to evolutionary progress. These remarks, it seems to the writer, have a bearing on the discussion whether mind, the so-called psychic content of human individuality, has any existence more or less independent of the biological organism, such as the body of man, with which it is usually associated.

Huxley[1] arrives at the following definition of evolutionary progress while discussing it in the final chapter of his recent book, *Evolution—the Modern Synthesis*, on page 564.

"We have thus arrived at a definition of evolutionary progress as consisting in a raising of the upper level of biological efficiency, this being defined as *increased control over and independence of environment* (Italics ours). As an alternative we might define it as a raising of the upper level of all-round functional efficiency and of harmony of internal adjustment". In other words, further evolutionary progress, further advance of the biological organism, lies in the direction of some state in which it gradually depends less and less on the environment, on physicalism, on the material conditions of life such as food, air, temperature, etc. This may mean that the advance of a biological organism, such as a human being, lies in getting independent of—if control means some independence—its biological or physiological activities, because, one wonders, what are physiological activities, the process of living, without environmental conditions. Is it not difficult to conceive of a biological organism, which is in a sense so much environment itself, getting increased control over the environment, that is, partly over itself, without the help of some energy, some agency on which the organism is dependent or with which it is associated? If the advance of the biological organism, such as a human being lies in getting independent of its environment, of its ecological conditions, one wonders, wherein lies the next field of evolutionary progress, the field for further advance.

Taking into consideration this scientific criterion of evolutionary progress it seems reasonable to support the inference of the philosopher that mind, 'I', may be an agency, an entity existing in its own right also. The investigation and understanding of its nature may be the next field of advance, of evolutionary progress. Hence our appeal for the recognition of the significance of human mind in world affairs.

It is true that we have not yet obtained any adequate conception of such a nature of mind. Could this elusive agency, 'I' be the element on which *Yogis* and many of the great sages of India have laid so much stress, towards which they have directed their gaze and which probably they attempt to realize in some of their most difficult practices?

PHYSICAL RESEARCH AND 'I'

As said above, the biological or the physiological concept of mind is that it is merely a functioning of the sense and motor organs in connection with the central nervous system of the biological organism. It is further believed by almost all men of science that this behaviouring is subservient to and lies within the operation of the scientific laws of physicalism as known to-day. In short, the attributes of the mind are the attributes of the organism and no more.

Scientific workers would, therefore, naturally demand some evidence, obtained by scientific methods of enquiry, to induce them to give further consideration to the alleged extra-corporeal existence of the psychic content or mind of the organism. Are there any queer, unusual, extraphysical attributes of mind, which will bear the weight of scientific analysis and criticism?

A. Extra-Sensory Perception (ESP)—

Biological organisms, such as human beings, perceive or see with the aid of eyes and thus gain knowledge of the events taking place in their environment. About sixty-four to sixty-five years ago, scientific investigations[2] were undertaken with a view to finding out whether other modes of perception occur and whether 'knowledge of things is acquired by a person in whatever manner, without the use of the ordinary channels of sense-perception, of logical inference, or of memory'. It was also their aim to learn more about such phenomena as are designated by the terms 'mesmeric', 'psychical', and 'spiritualistic'. These investigations took the name of psychical research.[3]

About the year 1930 Dr. J. B. Rhine[5] and his collaborators started a series of experiments at Duke University, North Carolina, U.S.A., to investigate the following problem:

"Is it possible repeatedly to obtain results that are statistically significant when subjects are tested for knowledge of (or reaction to) external stimulii (unknown and uninferable to the subject) under conditions that safely exclude the recognized sensory process?"

At the time of writing, many reports[4] of scientific researches, conducted over long periods of time, to find out whether an extra-sensory mode of perception (ESP) is experimentally demonstrable, have appeared. Several authoritative books[5] have been published reviewing scientific evidence to show that ESP and kindred psychical phenomena such as telepathy, clairvoyance, precognition, retro-cognition, etc., occur. Rhine[7] gave in June 1944 a short review of the progress and status of research on ESP during the preceding ten years or so. He says, "A greater number of important investigations of ESP occurred in this ten-year period than all the previous history that covers at least fifty years. Most significant of all the evidences of expansion is the extent to which the investigation of ESP has invaded the collegiate laboratory of psychology and involved the participation of psychologists themselves. ESP capacity was found among a wide range of subjects tested —male and female, children and adults, blind and seeing normal and abnormal". He adds, "But with regard to the physical world, the ESP process showed distinct peculiarities in every respect. In contrast to its relation to sensory perception, *physical law seemed to play no part in the process of extra-sensory perception* (Italics ours). Whereas visual stimuli are less intense, the further away from the eye, ESP success did not fall off with the removal of stimulus to greater distances. Other physical conditions too, such as the angle at which the object was placed or the interposition of the barriers, had no influcnce on the results. ESP was found to be unaffected by the spatial conditions imposed."

B. Psychokinesis (telekinesis) PK—

Rhine and his associates[4] have also undertaken to investigate experimentally whether mind can act directly upon matter, whether mind has power to exert its influence on the physical world without any recognized intermediate agencies. In February 1934 experiments were devised in the Parapsychology Laboratory of Duke University, America, to investigate, as Rhine[6] says, the claims of the gambler that the state of mind can influence the fall of dice. He came to the following conclusion in 1944, after ten years of these dice-throwing studies:—

"There is a direct psychical effect exerted on the fall of the dice. It is one of the most, perhaps *the* most, demonstrable of the phenomena of parapsychology. It is a psycho-physical effect which is kinetic in its result and may be termed *psychokinesis*, or PK. This effect may be fundamentally the same as the casual action of the mind on the brain, and psychokinesis need not necessarily involve distance. Names are of little importance, but this explains one of the main objections to the more familiar term *telekinesis* (movement at a distance)."

Some Reflections

Some of the results of the researches on "ESP-PK-process complex" seem to indicate that a biological organism, such as man, can perform some functions which at present cannot be explained on physiological principles, which are in their turn dependent upon our existing concepts of space, time and matter. They seem to be in certain respects *extra-physical* and *extrabiological*. From the evidence presented by psychical research, one may infer that these functions may be some unique attributes of the assumed entity called mind; these functions may bear witness to its existence, an existence more or less independent of the biological organism. These researches lend point to what Tyrrell[5] calls "this 'I-principle' this inscrutable something which we know only in the unique and unanalysable experience of being 'I'."

How are such academic discussions to help us in preventing men from quarrelling and inflicting great hardship, pain and suffering upon one another, where scientific discoveries and inventions too are pressed into service?

For ages past prophets, philosophers and many religious-minded people, desiring to see universal peace and harmony among men, have been extolling the dignity of man, the individual. They have laid stress on the spiritual part of the nature of man and have been constantly making an appeal for its recognition in the affairs of life. We know the wise admonition to man, to see his self in the other self, to be the promoter and guardian of his neighbour's welfare also.

Apart from sentiments and sympathy, do students of science see any reason, based on scientific evidence and on intellectual grounds, to agree with the statement that there may be some truth in this philosophic contention and religious appeal? In view of the growing influence and prestige of science in world affairs, do scientific workers, on the considerations set forth here, feel inclined to have the individual as the centre of interest in advocating a world policy for the government of men?

It may be that the 'I' stands behind the four freedoms. In our efforts for its spiritual realization, we see no intellectual compunction for science to hold back. And may we hope that the land that has given us the *Gita*, the land whose ancient philosophy, religion and culture have contributed so largely to the formulation of the ideal of 'self-realization' making it the supreme purpose of life, may produce many '*karma-yogis*' in science, not only to work for the material welfare of their country, but also to help philosophy and religion in making mankind see the error of its ways and in turning its gaze towards the significance and profundity of 'the I-principle'.

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PLOT SIZE IN YIELD SURVEYS ON COTTON

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AN important feature of province-wide yield surveys on cotton,[1] wheat[2] and rice[3] conducted by the Indian Central Cotton Committee and the Imperial Council of Agricultural Research is the large size of the sample plot, ranging from 1/60 to 1/10 acre. Workers in England[4] and America[5] have on the other hand concentrated on small plots of 10 or 12 sq. ft., and have developed methods of sampling conditioned by the scarcity of rural labour but excellent transport facilities and easy access by motorable roads to all parts of the tract to be sampled. Hubback[6] in the first sample survey ever carried out in India also used a small plot of 13·6 sq. ft. and recently Mahalanobis[7] adopted the plot size (actually 12·5 sq. ft.) together with Hubback's method of marking the plot by means of a triangular frame in yield surveys on wheat and gram in two districts of Bihar Province.

The question of plot size in Indian crop surveys has lately become a subject of considerable controversy.[8] The alternatives are the large plots employed in the I.C.C.C. and I.C.A.R. surveys and the small plots recommended by Mahalanobis. Crop cutting experiments on large plots are annually conducted by the Government departments concerned with the forecasting and estimation of crop yields in the temporarily settled provinces in British India and their choice of large plot is well justified on practical grounds. Sukhatme[9,10] has now published results on a more serious aspect of the comparison between different plot sizes and if his findings are found generally applicable, small plots must be rejected as giving highly biassed and, therefore, misleading estimates of yield. He showed that the use of small plots, ranging from 12·6 to 118 sq. ft., led to an overestimation of yield from 5 to 49 per cent. as compared to a plot size of 472 sq. ft. employed in the I.C.A.R. surveys, the smallest plot size giving the largest bias. An experiment on this problem was carried out on cotton in 1945-46 and the results are briefly described below.

The experiment was planned in two sections. The first was located at Indore in the fields of the Institute of Plant Industry and in four neighbouring villages. In all 26 fields were selected. The second section of the experiment was carried out at Government Farms in C.P. and Berar through the kindness of the provincial agricultural department. Here also there were 26 experimental fields distributed among seven Farms.

In earlier investigations[11,12] it had been established that precision of the results was not materially affected by changing the plot size from 1/20 acre to 3/10 acre. In the present experiment 1/20 acre was, therefore, adopted as the standard plot size with which it was proposed to compare two smaller sizes, 1/200 and 1/2000 acre. In each selected field two plots of each size or six plots in all were marked randomly according to the procedure of random selection employed in the cotton survey. Cotton in Central India and C.P. is sown evenly in rows with a row spacing of about 14″ and 18″, and unlike cereals and other crops which are either broadcast or sown in irregular lines in many parts of the country, plot area in cotton consists of a specified number of rows of a given length. Plot size in sample surveys on drill-sown crops in America[5] is similarly defined as a certain number of contiguous rows of a fixed length. In the present experiment, plots of 24 rows 78 ft. long, 8 rows 23 ft. long and 3 rows 6 ft. long, at Indore, and of 22 rows 66 ft. long, 7 rows 21 ft. long and 2 rows 7 ft. long in C.P., were marked as representing plot sizes of 1/20, 1/200 and 1/2000 acre respectively on the assumption of the above row spacings. After the pegs had been fixed at the four corners of a plot in the middle of the inter-row space, exact dimensions were measured in feet and inches and the actual size of the plot was calculated. The following were the average plot sizes obtained:—

Model plot size	*Actual plot size* Indore	C.P.
1/20 or ·05 acre	·056 acre	·054 acre
1/200 or ·005 acre	·0055 acre	·0054 acre
1/2000 or ·0005 acre	·00053 acre	·00053 acre

Actual plots were thus slightly larger than the corresponding model sizes owing to the distance between rows being a little wider than was assumed. The results of the investigation are strictly applicable to the actual plot sizes; but in the discussion that follows it is convenient to refer only to the model sizes to which the plots approximate.

There were 3 to 6 pickings in the plots at Indore and 3 to 5 pickings in C.P. The yield of each plot was converted into pounds of seed-cotton per acre by using the appropriate area factor before results were analysed statistically.

Average yield per acre estimated from the three plot sizes is shown below:—

Plot size	*Average yield lb. per acre* Indore	C.P.
1/20 acre	195·7	322·2
1/200 acre	197·0	354·9
1/2000 acre	221·3	421·8

There was a gradual increase in yield per acre as the plot size was increased in the C.P. experiment. At Indore also, the yield per acre from the smallest plot was larger than the other two plots which between themselves did not show any difference. A statistical comparison of the differences gave the following results:—

Plot size comparison	*Difference lb. per acre with s.e.* Indore	C.P.
1/200—1/20 acre	1·3 + 21·6	32· ± 20·7
1/2000—1/20 acre	25·6 ± 25·2	99·6 ±
1/2000—1/200 acre	24·3 ± 23·3	67·0 ± 58·3

None of the differences was significant; but the excess of yield estimated from 1/2000 acre plots over 1/20 acre plots in C.P. was almost twice its standard error and approached significance on the 5 per cent. level. There is ground for suspicion here that small plots, particularly of 1/2000 acre, overestimate yield. Overestimation in such plots has been established by Sukhatme in wheat and rice and the present results are in the same direction.

The comparison of yield estimated from sample plots with the yield obtained by harvesting the whole field is the ultimate criterion for judging whether the sample plots truly represent the fields. Complete yield data could not unfortunately be collected for fields at Indore as in certain cases the owners mixed the yield of two or more fields and two or three fields were damaged by cattle before their final picking was over. In the C.P. Farms, however, correct yield figures were recorded for all fields included in the experiment and their comparison with estimates from sample plots gave the following results:—

Comparison of plots with fields	*Difference in yield lb. per acre with s.e.*
1/20 acre plot—whole field	$26 \cdot 7 \pm 26 \cdot 5$
1/200 acre plot—whole field	$59 \cdot 4 \pm 28 \cdot 1$
1/2000 acre plot—whole field	$126 \cdot 3 \pm 57 \cdot 6$

The yield estimated from 1/20 acre plots agreed quite well with the yield for the whole field as the difference between the two was no more than its standard error; but the excess of the yield estimated from the other two plots over the yield from the whole field was greater than twice its standard error and clearly significant. This result provides evidence that plots of 1/200 acre size or less overestimate yield. With 1/2000 acre plots the overestimation was as high as 42·7 per cent. of the true yield.

The relative efficiency of plots of different sizes was studied though this point is of little practical interest owing to the biassed estimates that smaller plots give; but setting this consideration aside, the number of plots and fields required to be sampled to estimate yield with a standard error of 5 per cent. was calculated separately for Indore and C.P. from the observed values of intra-field and inter-field variability. From C.P. results, plots of 1/20, and 1/200 acre size did not appear to differ in efficiency, but five plots of 1/2000 acre were equivalent to a single 1/20 acre plot, *i.e.*, gave a result with the same precision, the number of fields being kept constant. At Indore both smaller plots had a much lower efficiency than the standard plot, and with 1/2000 acre plots even ten plots per field could not give an estimate with the same accuracy as provided by a single plot of 1/20 acre per field.

As far as the yield surveys on cotton are concerned the present results are limited to showing that the plot size of 1/10 acre adopted in these surveys (or 1/20 acre recommended for irrigated cotton) is well beyond the range of influence of border bias exhibited by small plots; but even if small plots were free from bias, it is improbable that they would be considered suitable in practice. Unlike cereals, cotton is harvested in several rounds of pickings and consequently the plot must be maintained intact in the field for 3 or 4 months and visited repeatedly. The produce of each picking should be sufficient in quantity for accurate weighment by ordinary balances. The dimensions of the cotton plot have to be fixed on these and other similar considerations. The important conclusion emerging from the present experiment is that small plots give biassed estimates of yield not only in broadcast or unevenly sown crops as shown by Sukhatme, but also in drill-sown crops with evenly spaced rows. While small plots used by English and American workers may not be open to serious objection for comparative purposes, the possibility that the yield estimates derived from such plots are seriously biassed needs a careful examination.

In his report on the Bihar crop survey[7] Mahalanobis considered the plot size of 12·5 sq. ft. marked by a triangular frame to be efficient, economical and convenient. It is interesting to note, however, that in a later article[8] he has recommended a circular plot of 50 to 100 sq ft. without giving any experimental data or precise reasons in support of this change; but Sukhatme's results have shown that the the latter plot size is also not free from bias. In the present experiment even a plot size of 1/200 acre or 218 sq. feet was found to overestimate yield. It is noteworthy that Sukhatme had tried circular plots marked by an apparatus very similar to that described by Mahalanobis, but his conclusion was that for a given plot size it made little difference in the magnitude of bias whether the plot was triangular or circular. The new plot size proposed by Mahalanobis would, moreover, be difficult for handling by the travelling investigator without the help of hired labour and would thus be deprived of the special advantage claimed for the smaller plots while retaining their defect in giving biassed estimates. On the experimental evidence discussed above, only large plots can be considered to be free from this serious drawback.

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THE CONCEPT OF VESTIGIAL ORGANS AND THE VASCULAR CRYPTOGAMS

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THE body of a plant is a complex organization made up of parts working together towards the common goal of maintaining its life. Some of these parts are concerned with the vital functions of absorption, assimilation and reproduction and others are there merely to help these. A few others do not undergo full development and are in no way concerned with the vital physiological processes and as such are quite useless. Such imperfectly developed parts in the body of an organism, in no way concerned with vital functions, "bearing a plain stamp of inutility" are called the vestigial organs. They are known to occur in many plants and are inherited with the same regularity with which the vital ones are inherited. But being in no way concerned with the essential process in the plant-life they seldom undergo modifications as do the other parts such as leaf or stem in response to the external stimuli acting on them. In fact they behave in this respect, in a manner quite opposite to that of the latter. Whereas with the passage of time the essential organs get modified according to the conditions under which they live, these organs get arrested or degenerated. Despite this fact they preserve their original character, though in a reduced form, in a very remarkable manner, and in course of time become "the unperished symbols of great antiquity". Viewed in this light the body of a plant is a bundle of some useful and some useless parts.

The form of such antic parts is often very simple, and therefore, systematists find it easy to trace their homology. In doing so they safely disregard the physiologist's warning that they are quite useless or ignore the anatomist's conviction that they are too simple, and use them in phylogenetic speculations. The number of such useless parts in the body of a plant is generally very small, although in stray instances it is so large as to give an impression that the whole body of the organism is a museum of such relict parts, *e.g.*, that of King-crab, *Limulus* in animals or that of *Welwitzia* in plants in which practically every degenerate part has some past history to proclaim.

As pointed out by Darwin[1] (1888), according to the earlier theories of 'Genesis' such parts found no satisfactory explanation. They were supposed to be present in the body of an organism either "to complete the scheme of Nature" or to "keep up the relations of symmetry" which they often did not. But according to Darwin's theory of descent through variations and Natural selection, they afforded another line of positive evidence in support of his theory. Ernst Hækel[2] (1886), Darwin[3] (1888), Goebel[4] (1900), Bower,[5,6] (1901, 1935), Jeffrey[7] (1917), Sahni[8,9] (1923, 1925), Browne[10] (1927) and others have used these structures in support of their views on certain problems in plant morphology; but on the whole, attempts at presenting them in a connected manner have been very few in botanical literature. The reasons for this are not far to seek. The examples of such wasteful heritage are far more numerous in animals than in plants. For example, in the body of man alone, anatomists have enumerated a few hundreds of such vestigial organs such as the rudimentary stalk of the pineal body in his brain, the nictitating membrane in the eye, seven useless muscles never called upon to move his ears, and a good many others in the neck to hold his head down, the embryonic tail of commensurable dimensions in the third week of conception, not to mention the vermiform appendage, wisdom teeth cut at later age, etc. A plant has no such array of useless parts. The fixity of life means a rigid discipline. It means no scope for ambulation, less scope for speciation, and hence for acquiring new organs to master the new haunts of life. Whatever organs it has, have to be used to the best possible advantage, and that too if possible for purposes more than one. A plant, therefore, can hardly be extravagant or over-exuberant in its expression of parts, much less in the expression of its useless parts. Secondly, by far the most important process in the life of the plant is the process of photosynthesis. The law of surface expansion is very important here. More the surface exposed, better it is for the plant; and to do that effectively many plants develop a diffuse form quickly. In attaining it some of the developmental stages are simply passed over in ontogeny and others are deleted. In doing so, however, each one of the innumerable growing points of a plant repeats the story of the development of the embryonic shoot on a miniature scale, and to quote Sahni (1925, p. 204), "in both space and time". Generally there is a tendency to delete obsolete parts: and the parts that succeed show a serial homology. For example, the first embryonic leaf is generally simple in the sporelings of many ferns such as *Osmunda* or *Marsilia* but becomes compound later after having passed through a series of transitional forms (see Bower,[11] 1923, pp. 87 and 93). In the sporelings of *Botrychium virginianum* and *Helminthostachys zeylanica*, however, the cotyledon is compound and trifoliate *ab initio*. The seedlings of some other ferns also omit the bifoliate stage like *Botrychium* and *Helminthostachys*. But despite such examples of rapid development involving the deletion of parts one is surprised to find that the vestigial organs occur in almost all the groups of plants, *e.g.*, the auxiliary cells in some red algæ, the suffultory cells in some species of *Bulbochæte*, the spermatia in many rust fungi, the paraphyses in mosses, the amphigastria, perigynia and perianth in some liverworts, the annulus in equiseta, the ligule in lycopods and selaginella, the aphebieæ in certain ferns, the stigma

in the flowers of *Welwitzia*, the papillæ representing a stamen or a pistil in flowers of angiosperms, the suppressed flowers in the spikelets of grasses, etc. These will suffice to show that the formation of vestigial organs is a phenomenon of very wide occurrence throughout the rubric of the plant kingdom. The present paper, however, deals with the vestigial organs of the vascular cryptogams mainly, as these plants constitute a compact and archaic group possessing some striking examples of such organs.

Some Characteristics of the Vestigial Organs

From what has been said above, it will be seen that the two important features of the vestigial organs are the simplicity of their structure and uselessness. The former is often quite obvious, but the latter is not easy to prove in many cases. Theoretically it is easy to conceive of some organs as useful and others as useless; but even then it is necessary to remember that those organs that are supposed to be useless now, are believed to have been useful in some remote past in the ancestors of plants which possess them to-day. In other words, their present vestigial state only indicates the negative extreme to which they have been driven from a state of usefulness through the operation of time and environment: and, therefore, it should always be possible to find several intergradations between these two extremes at any time in the history of the plant kingdom. And so it is. There are thoroughly vestigial organs, dwindling organs, arrested or aborted organs, atrofied organs, conservative yet simple organs, rudimentary organs, nascent organs, ephemeral organs, a long series of more or less useless organs. In each one of these the emphasis is not only on their simple character but also on their doubtful utility; and to reach a level of uselessness from one of utility, there must have been a long process, involving in the majority of cases millions and millions of years, if not billions. At any rate a consideration of the element of time in the history of these organs is of paramount importance as it is undoubtedly so in the case of those structures with which a palæobotanist deals. When this fact is realized much of the controversy over the relative importance of these organs in morphological discussions loses its sting; as in one's eagerness to prove that a particular organ is vestigial in such and such a group, one is likely to emphasise either its simplicity or its inutility or its antiquity. But such a unilateral emphasis on any one of these features is likely to lead to erroneous conclusions. What matters most in their consideration is probably the relative level of vestigiation shown by the organ concerned at any particular stage in the history of the plant both in the cycles of ontogeny as well as phylogeny. Thus an organ may develop only in embryological condition and may become vestigial in adult state. Some other organs may persist in adult condition but only in an arrested or atrophied form. Still others may remain nascent for all the time to come under normal conditions but under certain abnormal conditions may resume their original form. A few others may adapt themselves to some secondary function and look quite odd, *e.g.*, a root-like organ serving as a stem, *e.g.*, protocorm of *Lycopodium*, or a stem-like organ serving as a root, e.g., the rhizophore of *Selaginella*. From the phylogenetic point of view also, these must be carefully considered, as their occurrence is sometimes confined to the limits of individual plant, sometimes to those of a class. When they occur in two allied groups, we get good examples of recapitulation. Their testimony in phylogeny, therefore, has to be taken with a certain amount of scepticism, as the same organ may appear repeatedly in different periods in the past history of the same group; or it may occur polyphyletically in different groups at the same or different periods; and having lost its function, it may be reduced to the same level of vestige through a series of similar changes. The recognition of this fact is of great importance in dealing with them as many of our present-day series of plants are reduction series. And hence Goebel (1900, p. 61) warns:

> "Arrested organs may be such as generally in the existing species (or in its one sex) never reached complete development; it is only our synthetic necessity which forces us always to the assumption of reduction-series, of which, however, many can only claim to be fictions, imparting æsthetic pleasure of bringing a series of facts into connection with one another."

Keeping this precaution in mind we shall now make a brief survey of the vestigial organs of the vascular cryptogams.

A Survey of the Vestigial Organs of the Vascular Cryptogams

For the sake of convenience these organs will be discussed as under:—

(1) *Embryonic organs* which become vestigial in later stages;
(2) *Rudimentary organs* which never attain full growth under normal conditions of life but under exceptional conditions reveal their true nature;
(3) *Arrested* or *atrophied organs* which persist in a simple form in adult configuration; and
(4) Internal organs reduced to vestigial state; the *vestigial tissues*.

(1) *Embryonic organs*.—The true nature of the embryonic organs is often difficult to decide as they are ephemeral and as such represent only decadent stages in the early development of a plant. Secondly, whenever an embryonic organ is said to be vestigial, it is with reference to a particular cycle of ontogeny. It may or may not be vestigial in the life-cycle of another plant belonging to the same or another group. Three embryonic organs have been recognized as such. They are: (*i*) Foot, (*ii*) Suspensor and (*iii*) Protocorm.

(*i*) *Foot*.—It is well known that the root is a secondary organ of absorption of a leafy sporophyte, the primary organ of absorption being foot. The main function of the foot is to absorb food material from the tissues of the gametophyte till the young sporophyte developing on it is able to absorb food material for itself from the soil with the help of the root, when present. It is generally formed from the hypobasal half of the two-celled embryo and takes a position diametri-

cally opposite to that of the leaf in the quadrant stage. This possibly suggests that the leaf and foot have opposite polarities like those of root and stem. And, therefore, what root is to the adult sporophyte, the foot is to the young plant. But in further development of the plant as the root and shoot assume greater proportions, the foot dwindles and is left as a small vestige completely lost in the adult stage.

That foot is an organ of considerable importance was known long since, as it happens to be the only absorbing organ of the non-leafy sporogonia of the mosses and liverworts. In the Anthocerotes also it becomes an organ of great physiological significance. In the sporophyte of this group, *Notothylas* excepted, there is a basal meristem which gives rise to a series of tetrads of spores from below. These ripen acropetally and are dispersed by the hygroscopic movements of the columella and elaters through the valves of the sporogonium. On account of the basal meristem the sporophyte has an infinite capacity for growth: and to nourish such a growing sporophyte the foot becomes very massive and a permanent structure in the morphology of the sporophyte. The foot, therefore, in this group is no longer an ephemeral organ as in the majority of liverworts but an organ of considerable utility throughout the life of the sporophyte. In the great majority of ferns also, the foot is only an embryonic organ but in the embryos of *Marattia douglassi, Kaulfussia œsculifolia* and *Equisetum debile* it is a massive organ which persists much longer than it does in other plants of these groups. It was in consideration of such facts in the embryogeny of the Anthocerotes and the Eusporangiatæ that Campbell[12] (1911, p. 211) stated, now more than thirty-five years back: "Indeed so marked are the resemblances in the early stage of development that they make the inference almost irresistible that the Ophioglossaceæ must have descended from some simpler forms whose sporophyte bore a strong resemblance to *Anthoceros*." As a matter of fact the embryo of *Anthoceros* bears such a close resemblance to the embryo of *O. moluccanum* or to the adult plant of *O. simplex* that one is tempted to call *Anthoceros* almost a pro-*Ophioglossum*. The significance of Campbell's inference, however, became apparent only after the discovery of the Psilophytales from the Rhynian cherts by Kidston and Lang[13] (1917-1921) and after the discovery of the gametophytes of the Psilotaceæ by Holloway[14] (1917) and Lawson[15] (1917) in 1917. In the embryogeny of the Psilotaceæ, there is no root, the whole of the lower part of the embryo being considered to be foot. Curiously enough this foot of the Psilotaceæ bears a close resemblance to the foot of *Anthoceros* and is as much prominent in the embryo of *Tmesipteris* as it is in *Anthoceros*. Nay, at a certain stage in the embryogeny, the whole of the embryo of *Tmesipteris* is considered to be all foot by Holloway (1917). In the early life of the plant, therefore, the foot is a very useful organ in *Psilotum, Tmesipteris* and *Anthoceros*. This was a striking confirmation of the earlier idea that even in the early vascular plants the foot must have been a very useful organ and not only vestigial as in the later vascular plants.

In the examples mentioned above the foot is a useful organ for a long time in the life of the plant. Quite an opposite of this is seen in the endoscopic embryos of *Selaginella* and *Lycopodium*. In these plants the foot becomes vestigial at a very early stage in the embryogeny. In *Selaginella* the embryo being endosporic, it is nourished by the parent-plant. The gametophyte becomes consequently reduced and the food material is stored in the lower part of gametophyte in the form of a frothy mass. The suspensor pushes the embryo in this region, and the foot, therefore, is reduced to a vestigial state soon. Between these two extreme cases (1) where the foot is an extremely useful and persistent organ and (2) where it is a mere decadent useless stage, in the great majority of the vascular cryptogams, it is an ephemeral organ which becomes vestigial in adult condition.

The other embryonic organ which becomes vestigial in adult state is suspensor. Its main function is to change the direction of the growing embryo in such a manner as to push it in those regions where the food material is stored. It is a matter of common knowledge that this organ occurred repeatedly in different groups of plants in the history of the plant kingdom, *e.g.*, in the Lycopodiales, Filicales, Coniferales, Gnetales and in angiosperms. Its phyletic history shows that it is not of constant occurrence even within the limits of a genus, much less in larger groups such as classes or phyla. For example, it occurs in *Botrychium, Helminthostachys, Danea,* and *Angiopteris*; but it is not of quite constant occurrence in the first and the last genera mentioned above. Once Miss Lyon[16] (1915) was so much impressed by this structure that she actually proposed a new genus *"Sceptridium"* in the Ophioglossaceæ to include such species of *Botrychium* as have suspensor. It occurs in almost all the species of *Selaginella*, but it is said to be absent in *S. pumila* found in Cape Colony, South Africa (see Duthie,[17] 1926). Obviously then in suspensor we are having a decadent structure not of constant occurrence in phylogeny. According to La Motte[18] (1937) in *Isoetes* also it shows a great variability of direction.

As a rule the development of such decadent parts is very rapid in ontogeny and they disappear also very rapidly in the life-cycle: because, the parts that serve no useful purpose in the economy of a plant are last to appear and first to disappear, *e.g.*, the corolla in Cruciferæ or the calyx in Compositæ. Very often these organs show precocious development and on that account look very conspicuous in comparison to the surrounding parts at certain stages in embryogeny. Thus the suspensor of *Angiopteris* is the largest part of the two-celled embryo, and so is the foot in the early embryos of *Tmesipteris, Marsilia, Equisetum,* etc.

The third embryonic organ of the vascular cryptogams which becomes vestigial later is the protocorm. The students of cryptogamic botany are familiar with the classical theory of protocorm as the forerunner of the vascular sporophyte enunciated by Treub[19] (1884-1888). This organ develops as a massive structure in lycopods, having all the characteristics of a

shoot. It closely resembles the adult plant of *Phylloglossum* with its tuber and annual cluster of leaves as in some orchids such as *Habinaria diphylla*. To this embryonic tuber-bearing protophylls Treub has given the name "protocorm". He considered it to be an organ of great antiquity. But his claim was freely contested by Goebel[20] (1904) and Bower[21] (1908) who looked upon it as an organ of perennation having only physiological significance. Holloway[22] (1917-1920), however, in his researches on the prothalli of the New Zealand species of the genus *Lycopodium* found that this organ though of great use to the plant in perennation, is capable of dividing dichotomously and can bear bulbils as are found on the sporophyte of *Lycopodium*. And, therefore, he came to the conclusion that it is not an organ of mere physiological importance but also of phylogenetic significance.

But the most unexpected confirmation of Treub's views came with the discovery of the Psilophytales by Kidston and Lang (1917). In the morphology of these of primitive land plants, there is a swollen portion at the base, and especially in *Hornea lignieri*, which bears a close resemblance to the protocorm of lycopods. This means that we are able to telescope the existence of the protocorm of modern lycopods in the Devonian plants, a period of not less than 300 millions of years. What is then the real significance of this organ? Was not Treub[23] (1890) right in regarding it as a vestigial structure of great antiquity? Probably he was. Because, it is quite possible that this structure might have arisen as an organ *sui generis* which might have had in some remote past adapted itself secondarily to its present function later, for which it was not very well suited. And hence in course of time it may have become partly vestigial and partly useful as Holloway[24] (1920, p. 233) thinks. Such examples of secondary adaptations of vestigial organs are quoted by Darwin[25] (1888) himself. For example, the styles in the flowers of some Compositæ though vestigial for their original purpose, secondarily help to brush aside the pollen. This is really a good example of successful secondary adaptation on the part of a vestigial organ, whereas protocorm and rhizophore suggest imperfect secondary adaptation. To my mind the same is probably the explanation of the axes of intermediate character such as Nathorstiana stem base, rhizomorph of *Isoetes*, Stigmarin axes, rhizophore of *Selaginella*, etc.

Another good example of successful adaptation on the part of a reduced structure is to be found in the hydathodes of *Equisetum*.[26] It is generally believed that the Calamites had leaves larger than those of the modern *Equisetum*. The former had stomata on the adaxial surface which became useless later; but subsequently they got associated with a vein and were transformed into hydathodes of epithem-type, and are functioning as such in many species of living *Equisetum*.

(2) *Rudimentary or Nascent Organs*.—Apart from the vestigial organs noticeable in embryogeny, a rudimentary organ may persist to a much later stage in a nascent form. Ordinarily it does not reveal its vestigial nature; but under the strain of some abnormal conditions it is brought out very clearly. Two such examples at least are known. In some species of *Selaginella* there are small pads or protuberances in the axils of leaves in the place of rhizophores, *e.g.*, in *S. rupestris*. These generally remain localised, but under the exceptional conditions they grow out into normal rhizophores and bear even leafy shoots. The other example is to be found in the annulus of *Equisetum*. In the majority of species of *Equisetum*, the annulus does not bear any sporangia; but the annulus of *E. giganteum* and *E. prœaletum* is normally sporangiferous. What is more interesting, some species such as *E. palustre*, or *E. arvense* show this condition occasionally.

Many of the abnormalities interpreted as reversion to the ancestral condition are probably due to the fact that the organs in question have been retained in course of evolution in a very reduced form. It is on this hypothesis that Bower (1901) considers the abortive sporangia found at the base of the strobilus in many species of *Lycopodium*, *Selaginella*, *Isoetes* and *Psilotum* to be vestigial.

(3) *Arrested or Atrophied Organs*.—These also persist in adult configuration and it is only the comparative or the developmental history that reveals their true character. In the adult leaflet of *Nephrolepis*, *Osmunda* and some other ferns there is a small auricle at the base of the leaflet. This little organ represents the third lobe of the embryonic pinna which is tri-foliate and acquires its elongated adult form by suppressing the basal lobes through a series of developmental changes. Similarly on the adaxial surface of the sporocarp of *Marsilia* there are two or more teeth present which represent arrested pinnæ and confirm the foliar nature of that organ. The common kidney-shaped indusium of *Nephrolepis*, *Nephrodium* and other genera is supposed to have been derived from the cup-shaped indusium split into two parts outer and inner as in some Davalloid ferns. The inner indusium does not develop. Only the outer one develops and forms the usual kidney-shaped type. But in some genera of the Davalloid ferns to which *Nephrolepis* belongs the inner indusium is seen in a rudimentary form, *e.g.*, in *Hypolepis* (see Bower,[27,28] 1923, pp. 221-223 and 1928, p. 11). A similar vestigial indusium is also found in *Marsilia* and *Pilularia* which suggests their affinity with the Schizæceæ.

The spore-producing parts of the Ophioglossaceæ were a very controversial topic since long; but the discovery of the early Devonian plants in which sterile and fertile parts have been associated together, called telome, threw a new light on these structures. At the distal ends of the little sporangiophores arranged in two rows in *Helmonthostachys* there are clusters of small leafy outgrowths. These little appendages were meaningless so far. But now with the help of our knowledge of the Devonian genera we interpret these as vestiges of leafy parts which were of commensurable dimensions in the ancestors of the Ophioglossaceæ. The affinity of the Ophioglossaceæ to the Cœnopteridinæ, though remote, is largely based on this fact.[29] The same is probably the interpretation of the ligule of lycopods, *Selaginella* and *Isoetes* and also of the buds sometimes noticeable in the seedlings of *Osmunda* and in *Botrychium*.[30]

(4) *Vestigial Tissues.*—The last category of the vestigial parts found in the vascular cryptogams are the internal organs reduced to a vestigial state, the so-called vestigial tissues. A large number of examples of these are known; but I do not propose to survey them all here. Only a few striking examples are cited below.

It is well known that the centripetal xylem is not seen in the stem of living *Equisetum* but it was quite a general condition of the whole stock in the anatomy of Protocalamites. Curiously enough this condition is seen in the traces of the reduced vegetative leaves of *E. maximum* and in the traces of the reproductive leaves of *E. palustre* and *E. hiemale*. The condition here is identical with that of the leaf-traces in Lycopodinæ.

Another good example is to be found in the leaf-trace of the living Cycadales and the Cycadofilicales. In the Cycadofilicales of the Palæozoic period the bundles of the stem were always characterized by the presence of centripetal or cryptogamic xylem. But this is conspicuously absent in the stem of the living Cycadales. However, there is a clear and universal presence of centripetal wood in the foliar fibro-vascular bundles of the living Cycadales.

Similar vestigial traces of xylem are also found in the teeth on the sporocarps of *Marsilia* and *Pilularia* and in the ochreola noticeable at the bases of branches of *Equisetum* species. In many species of *Equisetum* ochreola lack vascular traces; but Milde[31] (1867) has found them in the ochreola of *E. arvense*, *E. limosum* and *E. hiemale*. It is well known that the nodal structure of *E. variegatum* and allied species where remnants of siphonostele are noticeable has been interpreted to be vestigial by many competent authors. The cambium found in the stem of *Botrychium*, *E. maximum* and *Isoetes* is also of a similar nature.

All these examples are quite sufficient to show the widespread occurrence and the variety of structures called vestigial in the vascular cryptogams. In dealing with them, it is obvious that the concept when structures are being considered is qualitative; and it is quantitative when the functions are being considered. This distinction, however, is not well recognised in botanical literature; but to my mind it is of considerable theoretical importance as will be seen from what follows.

The Origin of Vestigial Organs: A Rationale

We shall now turn to some theoretical considerations. How can the origin of the vestigial organs be conceived? There is but little positive information to which we can turn in answer to this question. We have no doubt sufficient information at our disposal regarding the course of their development and degeneration also but that does not take us much further. It is possible, nay probable, that an organ having gone out of use for several generations thriving under the same set of environments for millions of years may have been atrophied and reduced to a state of a rudimentary structure in heredity. But how can disuse ever act on an organ never used and already reduced and reduce it still further to a state of vestige? The principle of economy of materials in an expanding form of the body may perhaps be one of the reasons for this: but that does not solve the whole problem as there are cases on record where no such economy seems to have been effected, *e.g.*, in the production of a small papilla consisting of a few cells in a flower. The difficulty is genuine and has been well recognized by many investigators. Here is an example:

> "After an organ has ceased being used, and has become in consequence much reduced, how can it be still further reduced in size until the merest vestige is left: and how can it be finally quite obliterated? It is scarcely possible that disuse can go on producing any further effect after the organ has been functionless. Some additional explanation is here requisite which I cannot give."[32]

These lines come from an ardent investigator no less than Darwin himself. But we must remember that these lines were written by him in 1858 when he had not had any occasion to see much of the later development in the science of modern Biology. Too great a faith in orthogenetic continuity of species as Darwin had, can lead to no other conclusions than these. But with the recent advancement of the surging wave of mutation theory, the breaks in the life lines now appear to us to be more real than apparent. By some fruitful chance, by some strange reorganization of the chromatin matter, by some sudden change in temperature either hot or cold, by an unknown chemical or bacterial stimulus, by the action of some unseen and unknown radiations, the nucleus of a cell in a species undergoes gene-mutations which result in bringing out new forms with new morphological characters, howsoever small they may be; and some of these do persist in times to come. Some of these characters are stable and useful and help the organism in adapting itself to its environments and in mastering them better; and others are equally useless for all that. A few others are of doubtful utility and get simplified and reduced to a rudimentary state in course of time. Some of these useless features get secondarily adapted to some purpose other than the original one for which they were meant and become partly vestigial and partly useful. Still others result in monstrosities and bring forth odd forms with strange characters. Many of these are quite unstable and are soon lost in heredity, but some do persist and become vestigial. How significant in this connection is T. H. Morgan's finding that quite a large number of mutations he was able to induce in *Drosophila* resulted in the atrophy of some parts and were both unstable and useless.[33] But some of the gene-mutations of doubtful use do persist in the body of an organism. May it not be that in the plants also some such mutations have given rise to changes which resulted in producing parts apparently useless, at any rate of doubtful utility. Natural selection having acted upon these and having found them useless may have reduced some of them to a rudimentary state and others to a state of vestige only. However, it is necessary to state here that I do not want to suggest that every vestigial organ owes its origin to gene-mutations, though I do feel that many of them may have arisen that way. Natural selection having acted upon

them and having found them to be of no direct use to the organism, may have reduced them to a vestigial condition. Truly vestigial organs, therefore, would be those that have arisen in heredity qualitatively as parts *de novo* on account of gene-mutations and have persisted in heredity notwithstanding the plain stamp of inutility they might have obtained later. Herein then perhaps lies the rationale of a problem left quite open by the unbiased mind of Sir Charles Darwin.

I take this opportunity to thank Professor J J. Asana for his kindness in going through the manuscript and making me some useful suggestions.

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OBITUARY

ALEXANDER BOGOMOLETS

(1881-1946)

IN the death of Alexander Bogomolets the Soviet people have lost one of their best and most devoted scholars. He was born sixty-five years ago within the dreary walls of Kiev prison where his mother had been imprisoned for revolutionary activities by the Czarist regime. As a child he was marked for his exceptional abilities. After a brilliant high school career he joined the medical faculty in Odessa University in 1900, passed his final examination with honours in 1906, and was appointed Assistant Professor of Pathology. His researches on "Structure and functions of supra-renal glands both in the healthy and sick organisms" got him his doctorate in 1909. After one year's work in the physiological laboratory at Sorbonne he was appointed Professor of General Pathology in Saratov University which post he held till 1925 when he was elected Professor of Pathological Physiology at the Second Moscow University. On the death of Bogonov, Bogomolets succeeded him as the Head of the First Blood Transfusion Institute, Moscow.

Bogomolets' researches and contributions are varied and many. He established the lipoid nature of the secreta of cortex of suprarenal glands and originated the idea of iono-endocrinous regulation. He attached great importance to the reticulo-endothelial system and its role on longevity and immunity. He showed that the disturbances in the functions of this system led to a number of ailments and to premature old age. By causing immunity in animals using elements of reticulo-endothelial system he obtained a serum which was used in the U.S.S.R. with particular success during the war in the treatment of wounds and fractures. Bogomolets and his school undertook intensive study of conditions which facilitate longevity in certain parts of U.S.S.R. and elaborated modes for preventing premature old age and prolongation of life.

His publications include important works in the sphere of immunity, anaphylaxis, allergy, pathology of blood circulation and mechanism of the action of blood transfusion. In 1929 he was elected member of Academy of Sciences, Ukranian S.S.R., of which he subsequently became President. In 1932 he was elected member of the Academy of Sciences of the U.S.S.R. He achieved the highest honours possible in the Soviet Union; twice he was elected deputy to Supreme Soviet of U.S.S.R., and was the Deputy Chairman of Supreme Soviet of Ukranian S.S.R. He was one of the recipients of the "First-class Stalin Prize".

LETTERS TO THE EDITOR

A NOTE ON "THE POSSIBLE EFFECT OF THE ATOMIC BOMB TEST AT BIKINI ON RADIO RECEPTION", AT ABOUT 3·05 A.M. (I.S.T.) ON 25th JULY 1946

IT is known that an atomic bomb on bursting will give rise to a considerable mass of ionised vapour at a pressure of 10^8 to 10^9 atmospheres and a temperature of several million degrees. A large amount of radio-activity will be produced, part of which may decay quickly whereas some portion may persist. It is, therefore, expected that there may be ionization over the surface covering a very large distance and that the ionospheric conditions at lower or greater heights may also be affected. A study of the propagation of radio signals as well as atmospherics originating from points situated at large distances from Bangalore in the Bikini-Bangalore direction around the time of the test was undertaken.

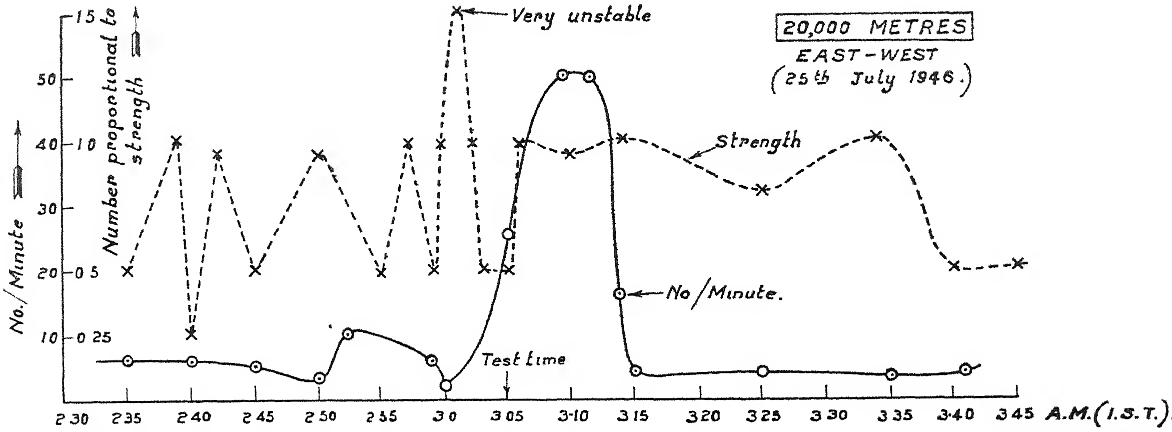
Bikini Lagoon is situated about 6,250 miles more or less due East of Bangalore (to be exact, 2°·5 South of due East of Bangalore). The experimental arrangements set up for *simultaneous operation* at the Department of Electrical Technology and the D.F. Hut of the Indian Institute of Science, Bangalore, India, were as follows:—

(1) British Radio Research Board Directional Recorder (for atmospherics) operating on 20,000 metres.—This was set up for study of the propagation of atmospherics on 20,000 metres from that direction (the origin of such atmospherics might be at very large distances from Bangalore and their transmission path would mostly be over the sea). The recording was arranged on the longest possible wavelength in long-wave band to include atmospherics originating at greatest distances.

(2) A sensitive field strength measuring arrangement set up for measurement of the electric field intensity of an American shortwave station on 25·3 metres in the direction of Bikini at Bangalore. Since a portion of the transmission path through ionosphere was in light and the other in darkness during the period of observation, the American station of 25·3 metres wave-length was selected for observation in preference to others on wavelengths shorter or longer than 25·3 metres.

The research workers taking part in the observations were Messrs. B. N. Prakash, S. M. Das-Gupta, N. V. Narayana Rao, J. Das, Amal Ghosh and S. K. Chatterjee. The time occupied in the observations was from 12 midnight to 5 a.m. (I.S.T.) on the 25th July 1946 (the atomic bomb test came off at about 3.05 a.m. I.S.T.).

Analysis of the observations made with the Directional Recorder operating on 20,000 metres has shown that the number of atmospherics per minute increased suddenly to a high figure at 3.05 a.m. and remained at a high level till 3.14 a.m. and that the strength of the disturbance varied rapidly remaining very unstable till 3.05 a.m. and subsequently became quite stable. Fig. 1 shows the observations for the period 2.30 to 3.45 a.m.



Results of observation on the American station on 25·3 metres have shown the following:—(*a*) The electric field intensity at Bangalore decreased considerably at about 3.05 a.m. and remained at a very low value from 30 seconds to 1 minute with the result that Signal/Noise ratio became extremely poor for reception. (*b*) The electric field intensity at Bangalore became negligibly small (similar to that in a "radio-fade out"), and the noise level very high from 3.52 a.m. to 3.55 a.m. so that the station was completely masked for about 3 minutes. From 4 a.m. onwards, the reception of the same station was fairly good, as before 3 a.m.

No definite conclusions regarding ionization either at lower (below 'E' layer) or greater heights or over the surface can, however, be drawn from the results of the above experiments due to a few uncertain factors. The note is meant to be a record of the effects observed on the reception of radio signals and atmospherics between 2.30 and 4 a.m. on the 25th July 1946.

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Bangalore, S. P. CHAKRAVARTI.
August 3, 1946.

THE APPARENT ENLARGEMENT OF THE SUN AND THE MOON NEAR THE HORIZON

It is a matter of common experience that the rising or setting sun and moon appear oversized when near the horizon. It is hard to believe, but true, that they are no bigger at the horizon than when they are at the zenith. The explanation for this phenomenon cannot be sought in atmospheric refraction; for, such refraction has the effect of causing not an enlargement, but indeed a slight diminution in the horizon sizes of the sun and the moon.[1] If we ignore this slight diminution, then there is hardly any change in the sizes of the images of these luminaries on the retina, as they move across the horizon. To explain this observation on purely geometrical grounds is thus impossible. The view that is generally held[2] seems to be that this illusion is an error of interpretation by the eye, which unconsciously adopts different scales for the measurement of objects in the sky according to their distances from the zenith. Due significance does not, however, seem to have been given in this connection to the sharp variation in the apparent luminosity of the sun and the moon when passing the horizon. The considerations set forth in this note would show that the tendency for the eye to employ diverse scales for the estimation of the sizes of the sun and the moon at the zenith and the horizon can be traced to the sharp variation in the apparent luminosity of those bodies as they move across the horizon.

For the sake of simplicity, we shall first consider the case of the setting sun. During the process of the apparent movement of the sun in the sky on any day, it is easily seen that the physical distance separating the earth from the sun is unchanged. The actual diameter of the sun is also an invariant quantity. The angle subtended at the eye by the sun is therefore constant, neglecting the slight detractive effect of atmospheric refraction. The apparent brightness of the sun in contrast with the background is, however, very much more at the zenith than at the horizon. For, as the sun nears the horizon, there is increasing absorption and scattering of the sun's light by the atmospheric constituents. As a result of this, the intensity of the light reaching the eye from the sun is reduced and the setting sun becomes increasingly red. The sun would thus seem to lose its brilliancy as it nears the horizon.

While investigating the apparent shape of the sky at sunset, the author has found that, with gathering gloom at sunset, the horizon appears gradually to drift into the distance.[3] In a recent paper on the apparent shape of the sky,[4] the author has put forward arguments for the view that the human eye tends to place darkening objects at increasing distances from the eye. The waning luminosity of the setting sun would thus incline the eye to feel the sun to be moving farther away.

The subjective estimation of the size of any object is based primarily on the angle subtended at the eye by the object and its apparent distance. If two spherical objects, both

equally bright but at different distances, subtend to the same angle at the eye, the eye has learnt to associate a greater size with the more disant object. Let us suppose that, while the angle subtended at the eye by the same object remains unchanged, its apparent distances increases. Then, the farther the object seems to recede, the bigger would be the size the eye would associate with the object. The sun subtends practically the same angle at the eye throughout its apparent journey across the sky but would seem to go farther away from the observer as its brightness decreases at sunset. This apparent increase in the distance of the sun from the observer, while the subtended angle remains virtually constant, would have the effect of causing the illusion of an enlargement in its size.

The setting sun appears largest when its luminosity reaches its minimal value. Further, on days when the sun's luminosity is greatly reduced, as by a hazy atmosphere, we feel the sun's apparent diameter to be correspondingly enhanced. The apparent enlargement of the setting sun may thus be an effect arising out of the variation of its apparent luminosity relative to the background illumination.

The over-estimation of the sizes of the rising sun or moon and the setting moon may be similarly explained as originating in the waxing or waning luminosity of those bodies. Again, the illusion of the full-moon looking larger than the sun though both these bodies subtend about the same angle on the average at the eye of an observer on the earth, may be attributed to the small luminosity of the moon compared with that the sun has at the same elevation above the horizon.

The author wishes to thank Dr. S. R. Savur, Ph.D. (Lond.), Regional Director, Regional Meteorological Centre, Madras, for his kind interest in the work.

Meteorological Office,
St. Thomas' Mount P.O.,
Madras, D. VENKATESWARA RAO.
June 5, 1946.

1. Sir John Herschel, *Outlines of Astronomy*, 1878, 35. 2. Sir William Bragg, *The Universe of Light*, 1933, 62. 3. Venkateswara Rao, D., *Curr. Sci.*, 1946, **15**, 40–41. 4. —, *Effect of Illumination on the Apparent Shape of the Sky* (under publication).

AN INSTANCE OF THE OCCURRENCE OF *MONILIA ALBICANS (CANDIDA ALBICANS)* IN DENTAL CARIES

IT is nearly a century since informations on the nonascusporogenous and filamentous yeasts called "*Monilias*" began to accumulate, but we cannot as yet say that our knowledge regarding them has gone beyond a mere beginning of a systematic study. These micro-organisms have been shown to be associated with a number of pathological conditions and other habitats. From 1853[1] onwards scores of papers have been published in connection with these organisms, but no attempt will be made here to review all the important literature. The year 1923, however, marks an important date, as it is in that year that Berkhout[2] suggested the generic name *Candida* for these micro-organisms till then loosely classified among monilias. For it is recognized by all medical mycologists that it is incorrect to use the term monilia as a generic term. Benham,[3] however, is of the opinion that the name established by usage in medical literature be retained. Whatever generic term may be kept, it does not in any way minimize the intrinsic difficulties encountered in their identification or lower their significance in medical mycology. The more recent publications of Stelling-Dekker,[4] Langeron and Talice,[5] Lodder,[6] Martin *et al.*,[7] Langeron and Guerra,[8] Martin and Jones[9] and Conant[10] have, however, dispelled a great deal of difficulties and led to a more accurate recognition of these micro-organisms.

The monilias are usually associated with thrush, but recently they have been suggested to have a role in dermatoses and pulmonary diseases. They have been also isolated from cases of carcinoma, tuberculosis and even from individuals with no definite or demonstrable pathologic lesions. Even though it is not the intention of the present authors to assign any ætiological role to *Monilia albicans* in the occurrence of dental caries, nevertheless, this species had been once isolated from a case of dental caries of a molar in its third degree of decay.

The presence of this organism within the pulp of the tooth is interesting from more than one point of view. Firstly, even though yeast and yeast-like organisms have been associated with buccal flora, there is not in evidence, so far as these authors are aware, a case where monilia have been found within the tooth or associated with dental decay. Secondly, this organism was isolated from carious lesion after the tooth had been subjected to a drastic chemical sterilization process not hitherto employed for animal tissues, but which has been employed with success for isolating bacteria from the root nodules.[11] This process was employed with great success by the authors in connection with their work on dental caries[12] and in one case a monilia was isolated.

It was with great deal of difficulty that the isolated organism could be identified as monilia. It presented difficulties because of its slight but successive changes in morphological and cultural characters. When it was first isolated, it microscopically appeared exactly like a yeast—round or oval yeast-like budding cells that are rather irregular. Colonies were moist and creamy. But gradually the structure and consistency of the colonies changed, and dry well-developed "tree-like" mycelium with chlamydosphores became the feature of the colonies. In the beginning a smear could be made easily from the colonies and stained with any of the stains such as Loeffler's methylene blue; but when the transformation was complete, it was not possible to make a smear and constantly the morphological features had to be studied by the split-disc method of Vernon[13] and examined after staining with lactophenol. Such changes had been observed by several workers.

A complete physiological examination conducted on the lines recommended by Martin

et al.[7] and later reported by Mackinnon *et al.*[14] which included tests for growth in alcohol, assimilation of nitrogen, gelatin liquefaction, carbohydrate reactions, growth in corn-meal agar, etc., clearly revealed that the isolated organism was none other than *Monilia albicans* (Candida albicans). Even though the Duke Hospital Report[7] indicates 47 out of a total of 124 monilia cultures to have had their origin in sputum, still, in view of the fact that *M. albicans* has not yet been reported to have been found in the interior of a decaying tooth, it is hoped that this note will be of interest to those interested in monilias.

Microbiology Dept.,
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Bombay, MEENAKSHI V. SHETTY.
August 1946.

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MARCASITE IN TRAVANCORE LIGNITE

THE occurrence of marcasite has already been reported in the Geological Reports of Travancore.[1] But no work on the chemical aspects of Travancore marcasite seems to have been done. The purpose of the present work is to determine the percentage of marcasite in Travancore lignite and also to explore the possibility of the utilisation of its sulphur content.

In Travancore, marcasite occurs distributed in the lignite beds at Varkalai and also in certain localities in the north. It is present as tin white cylindrical pieces varying in diameter from ¼″ to 1″ nd also as small concretions and nodules inside lignite. Representative samples were collected along with the surrounding lignite from six different localities. Each was crushed and weighed after drying in the sun. The marcasite in it was then separated by gravity-washing, and again weighed after drying. The results of this experiment with the six samples gave an average of 5·6 per cent. by weight of marcasite to be present in lignite. The specific gravity and chemical composition of marcasite as known[2] were identical with those of the mineral under investigation. On treating the mineral and also authentic specimens of pyrites with hydrogen peroxide, sulphur separated only in case of the latter, thus establishing that the mineral was marcasite.[3,4] Known weights of the mineral were roasted, separately in a combustion tube, and the gaseous oxides of sulphur evolved were absorbed in alkali. It was then oxidised by bromine water, and the amount of sulphur was estimated as barium sulphate. It was seen that the whole of the sulphur could be made available as gaseous oxides.

Although marcasite obtained as bye-product in coal mining industry has been used as raw material in the production of sulphuric acid in Germany and America[5,6] it is not possible to pronounce any opinion on the matter about Travancore marcasite because the extent of lignite deposits at Varkalai is under investigation and so the amount of marcasite that could be obtained is uncertain.

Chemistry Department,
University College, K. VISWANATHAN NAYAR.
Trivandrum,
July 26, 1946.

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CHEMISTRY OF KURCHI SEEDS PART IV. ISOLATION OF GALACTOSE FROM THE PICRIC ACID HYDROLYSIS OF THE GLYCO-ALKALOID

IN a recent communication to this *Journal*, the isolation of a glyco-alkaloid from kurchi seeds and its hydrolysis with aqueous hydrochloric acid have been reported.[1] It seemed advisable to use picric acid as the hydrolysing agent as it would also precipitate one of the hydrolytic products, *viz.*, the base as an insoluble picrate. The filtrate from the picrate, after treatment with lead acetate to remove phenolic bodies, was expected to yield the sugar. This method proved quite successful and led to the isolation of galactose which was characterised by its melting point, specific rotation, formation of mucic acid on oxidation with nitric acid, and the preparation of its osazone.

3·6 G. of the crystalline glyco-alkaloid[1] dissolved in 15 c.c. water, was treated with a saturated aqueous solution of picric acid till there was no further precipitation. 0·5 G. of precipitated picrate gave on crystallisation from alcohol 0·1 g. of sparingly soluble conessine picrate, m.p. 220-21° C., and the alcohol-soluble picrate yielded on crystallisation from aqueous acetone (1:1) 0·1 g. of yellow needles, m.p. 113-16° C., the base from which is being investigated. The filtrate after removal of picrates was treated with 20 per cent. lead acetate solution till no further precipitation occurred and the filtrate from the lead precipitate was de-leaded by hydrogen sulphide. The filtrate was decolourised with norite and the

decolourised solution evaporated to a syrupy residue (1·7 g.). The syrup on repeated extraction with cold absolute alcohol yielded 0·1 g. of sugar in the form of a white powder, m.p. 130-160°. 0·047 g. in 10 c.c. aqueous solution gave in a decimeter tube a rotation of $+0{\cdot}40°$. Therefore $[\alpha]^{25}_{D} = +85°$. On oxidation with 1·2 nitric acid the sugar gave an alcohol-insoluble product, m.p. (190°-) 210° corresponding to mucic acid and with phenylhydrazine the sugar gave an osazone, m.p. 200° proving the sugar to be galactose.

My thanks are due to Mr. P. Ramaswami Ayyar for guiding the work and to Dr. P. C. Guha for kind interest.

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Bangalore, (MISS) R. J. IRANI.
August 5, 1946.

1. *Curr. Sci.* 1946, **15**, 106.

REFRACTIVE INDEX OF MILK

IN the course of experiments on the determination of refractive index of milk with the Abbè refractometer, the separation of fat from the milk enabled an accurate determination of the R.I. without affecting the value obtained. This figure, it will be noticed, represents, unlike the usual figures for milk sera, the true refractive index of *milk*. After a few trials, the following method was devised for the quick determination of the R.I. About 10 c.c. of milk in a Gerber butyrometer is centrifuged for five minutes in an ordinary milk centrifuge, the defatted milk carefully collected and tested for R.I.

Nearly 100 genuine samples each of cow and buffalo milk from the Military Dairy Farm, Hebbal, Bangalore, and about 20 random samples from animals under widely differing conditions of management in the City were analysed and tested for R.I. (40° C.) as described above. The R.I. of all the samples of cow milk was confined to the range 1·3449 to 1·3471, while that of buffalo milk lay between 1·3460 and 1·3492, the most frequent value for cow milk being 1·3450 and for buffalo milk, 1·3480. The refractive constant 'K' (Lorenz and Lorentz[1]) for each type of milk was more distinct, and fell within still narrower limits. For cow milk 'K' was between 0·2065 and 0·2075, and for buffalo milk, 0·2076 and 0·2088.

From the available data it is concluded that cow milk with R.I. $< 1{\cdot}3449$ and $K < 0{\cdot}2065$ and buffalo milk with R.I. $< 1{\cdot}3460$ and $K < 0{\cdot}2076$ can be considered to be adulterated with water. Viewing the R.I. and K in conjunction with each other, it is in general, possible to detect samples of watered buffalo milk designed to pass off as cow milk. In such instances, while the R.I. is too high for cow milk, K will be found too low for buffalo milk.

Added skimmed milk in buffalo milk can be detected, as a rule, upto about a minimum of 25 per cent. adulteration when the rising density tends to lower K without affecting the R.I. This is not, however, equally helpful with cow milk where larger additions of skimmed milk are possible without abnormally affecting the constants.

Added sugar in milk, watered upto a minimum of 10 to 15 per cent., can be detected by the lowering of both the R.I. and the refractive constant below the normal levels.

The details of the experiments will be published elsewhere.

My thanks are due to Mr. B. N. Banerjee and Prof. V. Subrahmanyan for their kind interest in these investigations.

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Indian Institute of Science, K. S. RANGAPPA.
Bangalore,
July 18, 1946.

1. Lorenz and Lorentz, *Food Analysis*, Woodman, A. G., Mc-Graw Hill Book Co., London and New York, 1941, 140.

INCOMPATABILITY OF FILTERABLE YEASTS

SULC[1] in 1910 and Buchner[2] in 1912 have created new genera for some micro-organisms which have been reported to be exclusively found in symbiosis with insects and have been named Cicadomyces, Aleurodomyces and Coccidomyces. So far no bacteriologist has come across with them and I have pointed this fact to throw one more doubt on their being considered living entities. However, there has been a single exception which is also to be interpreted as confirming my criticism. P. A. Lewis,[3] under the title of a filterable yeast-like microorganism, discusses microorganisms, found by Sulc in symbiosis with some insects, which, according to Lewis, were "classified by Sulc as the smallest of the yeasts; length 1-2 μ".

Lewis was not the only worker to have been misled by the special literature on symbiosis. In a previous communication I[4] have shown how the symbiote of *Tachardina lobata* was first considered a bacterium by me but on consulting the literature I subsequently looked upon it as an yeast. Further work, however, convinced me that my original view was the correct one. Lewis was an expert microbiologist; no one works on yellow fever virus as he did without perfect confidence in bacteriological technique. A mistake from such a worker requires an explanation. But let us consider facts first.

Lewis subsequently died of yellow fever as a martyr to scientific research and his successor, Dr. Schope, kindly sent me a reprint of his paper with other relative information. A culture of the filterable yeast, *Schizosaccharomyces filtrans*, was deposited by Lewis with the American Type Culture Collection, Chicago, which kindly supplied me with a tube. I was working then in the Institute of the late Prof. Breindl of Prague who was engaged on the virus of typhus fever but subsequently died of it. The filterable yeast proved to be a bacterium most allied to *Micrococcus roseus*, a culture of which was available

in Breindl's Institute. The organism of Lewis, however, produced a paler rose colour than *M. roseus*, whereas microscopically there was hardly any difference between the two. How Lewis could have mistaken a Micrococcus for an yeast can only be explained by the fact that statements in print are sometimes taken for unchallengeable facts. That bacterial cells can assume giant forms and occasionally resemble yeasts have been confirmed by many workers and Löhnis and others have built complicated theories of life-cycles among bacteria upon such findings.

It is only pertinent to mention that in another communication, I propose showing how Cicadomyces and allied genera are really tissue debris while most symbiotes of insects are bacteria proper.

Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
July 23, 1946.

1. *Sitzb. K. Bohm. Ges. d. Wissenschaften*, Prag. 1910. 2. *Archiv f. Prot*, 1912, **26**. 3. *J. Exp. Med.*, 1927, **14**, 277–90. 4. *Curr. Sci.*, May 1946, **15**, 135.

THE CYTOLOGY OF YEAST

UNCERTAINTY still exists as to the exact number of chromosomes in *Saccharomyces cerevisiæ*, as found by various workers. It may be true as suggested by M. K. Subramanian[1] that "different chromosome numbers given by various authors may be due to studies of different races passing under the name of *S. cerevisiæ*". This, however, can also be attributed to not having used the best suited stain and fixative.

The technique employed in our study is the same as reported in our previous communication,[2] except for the fixative. The best fixative was Bouin's solution in which the smears were kept for forty minutes. Special treatment is, however, necessary to remove the last traces for picric acid for good staining. This is done by dipping the slides in 70 per cent. alcohol made alkaline (pH about 10).

In an actively dividing cell 12 chromosomes are seen which number is in complete agreement with Srinath's finding.[4] In the initial stages of division the chromosomes are seen in the middle of the cell, in scattered condition, as shown in Fig. 1. In the final stages the chromosomes arrange themselves in a very characteristic manner, forming a circle, as shown in Fig. 2.

There is some discrepancy between the findings of Srinath regarding centrioles. He mentions in one publication,[3] that one to five bodies are stained with Feulgen's reagent, but only illustrates four of them. He has further stated that they appear in the intranuclear vacuole, and regards them as nuclear material. In his next publication,[4] with a modified technique, only two bodies were stained with the Feulgen's reagent and he regards them as centrioles. This statement evidently shows that according to him one to five bodies which were mentioned as nuclear material are to be regarded now as centrioles. We observed that when *S. cerevisiæ* is stained with Feulgen's reagent certain bodies are stained which are not definite in size, shape and number. As the results are inconsistent it is not possible to arrive for the present at a definite conclusion.

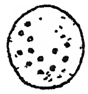


FIG. 1.

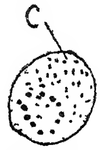


FIG. 2.

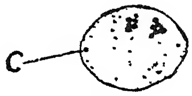


FIG. 3.

X 1200

On the other hand slides stained with toluidine blue indicate the presence of two more bodies in addition to the chromosomes. They are constantly present in a dividing cell, and can be easily distinguished from the chromosomes by their small size and separate position in the cell, as shown in Figs. 2 and 3. Due to difference in structure, behaviour and the location of these bodies, they should be regarded as centrioles. We have already made a mention of these bodies in our previous communication.[2] Further work is under progress.

We desire heartily to acknowledge our indebtedness to Professor S. Mahdihassan.

Biochemistry Department,
Osmania Medical College,
Hyderabad (Dn.), MOHAN BABU NAIDU.
July 23, 1946. V. M. BAKSHI.

1. Subramanian, M. K., and Ranganathan, B., *Curr. Sci.*, May 1945, **15**, 132. 2. Mohanbabu Naidu and Bakshi, V. M., *Ibid.*, June 1946, **15**, 164. 3 Srinath, K. V., *Ibid.*, Jan 1946, **15**, 25. 4. —, *Ibid.*, Feb. 1946, **15**, 50.

NUTRITIVE VALUE OF SOYA-BEAN AND RELATED PRODUCTS

WITH reference to your review[1] of the Report of the Soya-bean Sub-Committee of the Indian Research Fund Association, the following account of our recent work would be of some interest.

Practically all the work done by the Soya-bean Sub-Committee related to the use of the whole bean in the steamed or otherwise cooked condition as a *dhal*. In this direction soya-bean has proved disappointing and the conclusions reached by the Sub-Committee have been confirmed both by us at Bangalore and by investigators in other parts of the world.

In countries where soya-bean is finding very large application as an article of human food, it is mostly used either as a milk or as a

sauce. The former is a natural emulsion incorporating the protein, fat and minerals of the bean, while the latter is a pre-digested product. The work of the Soya-bean Sub-Committee had not included these two products.

The authors of the present note were present at the last meeting of the Soya-bean Sub-Committee which met in Delhi towards the end of November 1946. This meeting discussed the draft report of the Sub-Committee which was then being got ready for publication. It was the unanimous feeling of the Committee that a great deal more work on different aspects was needed, but that as the Committee had already completed a certain programme of work, the available material should be published. The draft report had gone beyond the actual work done by the Committee and as already fresh evidence was coming forth to reveal the higher nutritive value of soya-bean in a processed form, the report was modified in a number of places to provide scope for fresh developments. In fact, even at this meeting, both we from Bangalore and Dr. K. P. Basu from Dacca adduced evidence to show that soya-milk had a supplementary value when added to a rice diet, whereas the whole soya-bean had none.

At their meeting during the Autumn of 1944, the Soya-bean Sub-Committee had decided to close their work. Reference to this may be found in their earlier report. With this as a background, we started our work, about twenty months ago, studying the effect of each step in processing on the nutritive value of the resulting product. Independent evidence was also accumulating, chiefly in America, to show that the biological value of the protein was not a constant entity, but depended on the method of processing employed. By incorporating a number of improvements such as incipient germination, extraction to remove colouring matter and bitter principle, fine mechanical pasting, adjustment of reaction, and boiling under certain standard conditions, we showed that it is possible to obtain a vegetable milk which has the same properties as animal milk, at a fraction of the cost of the latter. We showed that the protein of the milk has a higher digestibility than that in cow's milk; that the biological value is not much lower and that the net values of the two proteins are practically the same; that the vitamin B complex of the two milks are of the same order; that, when added to the poor rice diet, soya-milk has a supplementary value corresponding to about 80 per cent. of that of the best cow's milk; that extended germination to about three days yields a protein with a higher biological value than that in cow's milk; that supplementing with calcium leads to further increase in nutritive value. We have also studied the effect of combining soya-bean with the commoner pulses, legumes and cereals with a view to producing a still better milk, but that part of the work is not relevant to the present subject.

We did not merely stop with the laboratory work and animal feeding experiments. We conducted an extended series of consumer trials with the milk, curd and related products. Thousands of people have sampled our products. The various products and, particularly the sour curd, have been much appreciated by all the users. Food preparations incorporating soya-milk or curd are indistinguishable from those prepared out of cow's milk.

With the above as a background and with the collaboration of the Health authorities of the C. & M. Station, we have been conducting a series of feeding experiments with the children in the local Welfare Centres. Soya-milk is being compared with cow's milk for feeding children ranging in age from a few months to seven years. The study is not yet complete, but the trends show that, especially in very young children, soya-milk produces better response than cow's milk. Experiments have also been recently started providing soya-curd and rice as a mid-day meal to well over a thousand primary school children. The number of children would have been much larger but for the fact that we are not at present in a position to supply more than about 400 lbs. of curd per day. In this connection, it may be mentioned that the panel of selection (which included the Rationing Adviser to the Government of India) actually preferred the rice prepared with soya-curd to that with cow's milk curd. Experiments will also be soon started comparing soya-milk with cow's milk in children's hospitals. Preliminary trials have already shown that children and invalids digest soya-milk more easily than cow's milk and that there is absolutely no ill-effect resulting from the use of the latter.

Side by side with the above, the technological side relating to the large-scale production of milk is being developed. Even with the limited equipment at our disposal, we could now produce over 1,000 lbs. of milk per day. Our present production is about 550 lbs., but we hope to double it at a very early date.

Thanks to the generous support of the Council of Scientific and Industrial Research, the Food Department, the Lady Tata Trustees and the C. & M. Station, Bangalore, we have already got a fairly big team of research workers on the subject. Further support will soon be forthcoming. Every aspect of the subject will be studied not only with a view to providing a complete scientific background but also to standardise the conditions for preparing a completely balanced vegetable milk that will have a higher nutritive value than the best grade dairy-fed cow's milk. We have already obtained promising results in this direction.

During the past twelve months, we have published some technical and popular articles bearing on the milk problem in the country;[2] the importance of processing in determining the nutritive value of soya-bean;[3] preparation of soya-bean milk.[4] Our technical papers relating to the preparation of soya-sauce,[5] biological value of soya-milk protein,[6] vitamin B complex of soya-milk,[7] supplementary value of soya-milk to rice diet,[8] and *in vitro* digestibility of soya-milk[9] are under publication. Further work bearing on the effect of combining soya with groundnut as also certain cereals and pulses, and on the calcium fortification of soya-milk

has been completed and is now being written up for publication.

S. S. De.
V. Subrahmanyan.

Dept. of Biochemistry
Indian Institute of Science,
Bangalore,
July 8, 1946.

1. *Curr. Sci.*, 1946, **15**, 158. 2. *Sci. and Cult.*, 1946, **11**, 692. 3 *Ibid.*, 1945–46, **11**, 437. 4. *Curr. Sci.*, 1945, **14**, 204; *Ind. Farming*, 1946, **7**, 17; *Bull.* 7 of *the Food Conservation League, C. & M. Station Bangalore*, 1946. 5. *Ind. Farming*, 1946, under publication, 6–9. *Annal. Biochem. and Expt. Med.*, 1946, accapted for publication.

ACCLIMATISATION OF *CYPRINUS CARPIO* TO THE PLAINS WITH NOTES ON ITS DEVELOPMENT

Besides the English carp* *Cyprinus carpio* proper, three varieties of the species, *viz.*, the Mirror carp, the Scale carp and the Leather carp, are found to thrive in the Ootacamund waters. A brief account of the introduction of the Mirror carp in the Nilgiris was recently given by Chacko (1945).[1] The English carp was acclimatised to the lower elevations as at the Sunkesula fish farm (1,000 ft.) in the year 1923. Recently we have succeeded in bringing down the Mirror carp also to the plains straight as far as the coast of Madras. In October 1945, five fingerlings of Mirror carp, of an average length of 5·5 inches were successfully transported direct to Madras and introduced in a pond in the Chetput Farm.

Without any previous conditioning, six fingerlings ranging from 5·3 inches to 5·7 inches were taken in a double tin carrier at mid-day on 28-10-1945 from Ootacamund. At Coimbatore the water was partly renewed (about half) at 7 p.m. and a twenty-pound block of ice was placed over the perforated lid of the tin carrier. The gradually melting ice, dripping down, kept the water in the tin fairly cool. On reaching Erode, at 10 p.m. the water was again half renewed. The block of ice kept on cooling the water till about an hour before reaching Madras and all the fingerlings arrived at the destination next morning in good condition. The tin was brought and kept partly immersed in the Chetput pond for a couple of hours' after which the fish were transferred to a conditioning box in the same pond. By noon three fingerlings were found showing signs of distress, swimming at the surface often upside down in a giddy manner. By the next morning one specimen was found dead while the rest moved about in a perfectly normal condition. Feeding was tried at 10 a.m. dropping crumbs of bread and the fish were seen to nibble at them. Thus the fish stood the transport of 355 miles, from an altitude of 7,000 ft. practically to the sea-level and adjusted themselves to the warmer environments in a remarkably short time. The temperature of water at Ootacamund was 17·2° C. and that at the Chetput pond 30·64° C. The fish thrived well in the pond at Chetput which also contained Gourami, Catla, Pearl-spot, Mullets and Murrels. On 24th December 1945, a specimen which was netted measured 9·8 inches in length representing a growth of 4·3 inches in 55 days. Two specimens were again netted on 11th March 1946 and they measured 15·0 and 13·5 inches in length and weighed 30 and 28 ounces respectively. They were netted for a third time on 5th May 1946 when they measured 17·5 (weight 2 lb. 14 oz.) and 15·6 inches (weight 2 lb. 9 oz.) respectively. The larger specimen was a mature male. The rate of growth is remarkably quick—about 2 inches per month—and it clearly indicates the adaptability of the species to different environments involving wide ranges of temperature and other hydrobiological factors.

Further consignments of fingerlings have recently been successfully transported to Madras and stocked in the farm ponds, and additional data on their growth and maturity in the new environments are being gathered.

Breeding is found to be at the maximum from January to March in the Nilgiri waters. With a view to properly identify the larvæ and fry of the different varieties, attempts were made to strip and artificially fertilize the ova. Several oozing male and female specimens of English carp were obtained in March from the Ootacamund lake and on 16-3-1946 a batch of several hundreds of ripe eggs were stripped from an oozing female and successfully fertilised by milt obtained from an oozing male. The fertilized eggs were carefully reared to hatching. The fry are thriving well in aquaria on artificial feeding. The different stages in development have been carefully followed and a detailed account of the same together with interesting features of bionomics of the species are under preparation for publication.

Our thanks are due to Dr. T. J. Job for his kind suggestions.

K. H. Alikunhi.
V. Runganathan.

Freshwater Biological Research
Station, Govt. Fisheries,
Madras,
May 18, 1946.

* The English carp differs from the varieties of *C. carpio* in several features and the details of the systematics of the species are under examination.

1. Chacko, P. I., *Jour Bombay Nat. Hist. Soc*, 1945, **45**, No. 2.

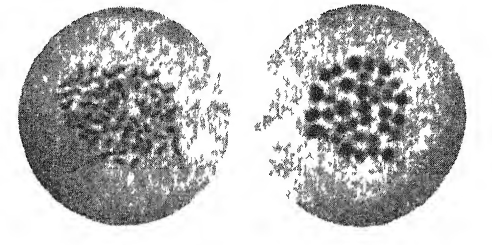
Published with the kind permission of the Director of Industries and Commerce, Madras.

CHROMOSOME NUMBERS IN BAMBUSEAE

In a previous communication[1] it was mentioned that the number of chromosomes in *Bambusa arundinacea* is $n = 35$ and $2n = 70$ though the previous record[2] for the same was $2n = 72$. I have had occasion in 1942 to examine the root and flower material of *Dendrocalamus strictus*, the flowering stalks of which were grown at the Sugarcane Breeding Station, Coimbatore, for hybridisation work. From a very careful examination of the chromosomes both at mitosis and meiosis it is found that

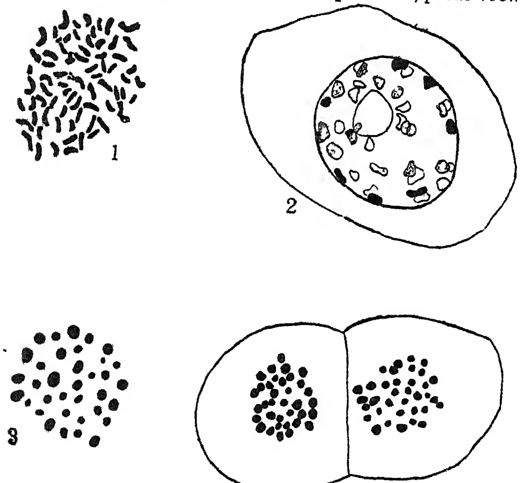
this species has also the chromosome number $n = 35$ and $2n = 70$, while Riccharia[3] and Janaki Ammal[4] record $2n = 72$ from root tip counts. Almost all the chromosome numbers recorded for the bamboos are from root tip counts as these flowers very rarely and it is really fortunate that flower materials could be obtained for the species mentioned here.

The chromosomes are figured at diakinesis, metaphase I and II of meiosis and also photomicrographs of somatic and meiotic metaphases are put in to show the nature of the preparations wherefrom this number is recorded.



A B

A. *Dendrocalamus strictus*—Somatic metaphase, polar view.
B. *Dendrocalamus strutus*—Metaphase I, polar view.



4

1. Somatic metaphase (*c. f.* Photomicrograph A) $2n=70$
2. Diakinesis
3. Metaphase I. (*c.f.* Photomicrograph B) $n=35$.
4. Metaphase II.

From the published chromosome numbers[4] for the different genera of the bamboo tribe, it is found that mostly all of them come under $n = 35$ and $2n = 70$, while Riccharia groups with the basic number $n = 12$. It is felt, however, that more intensive investigations in this tribe are necessary in view of the discrepancies in the chromosome counts of the above two species and also it can be seen that any likely error of one or two chromosomes in the counts may change our conception of the basic number of the tribe from $n = 12$ to $n = 7$ or *vice versa*.

Sugarcane Station,
Coimbatore, N. PARTHASARATHY.
June 25, 1946.

1. Venkatraman, T. S., and Parthasarathy, N., *Curr. Sci.*, 1942, **11**, 194–5. 2. Janaki Ammal, E. K., *Nature*, 1938, **141**, 925; Ucchikawa, I. *Imp. Bur. Pl. Genetics, Plant Breeding abst.*, 1936, **6**, 289. 3. Riccharia, R. H., and Kotwal, J. P., *Ind. Journ. Agric. Sci.*, 1940, **10**, 1033. 4. Darlington, C. D., and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945, George Allen & Unwin Ltd., London.

ANOTHER PROBABLE ORIGIN OF THE WORD CHEMISTRY FROM THE CHINESE

It has been previously[1] suggested that the word Chemistry is a Chinese derivative and that the French word, Chemie, sounds very much like the original. The Cantonese term Kim-Mi, signifies gone astray in the search for gold. Names are usually given by others. For example, Protestants, who now designate themselves as such, were so called, by people unsympathetic to them. Similarly Kim-Mi, or misplaced enthusiasm for gold, would be a name given by the critics of alchemy. Moreover, there has always been a greater preponderance of critics than of enthusiasts of alchemy so that the term which acquired currency, must have been the one used by the majority. It was such a consideration that formed the basis of my earlier[1] communication.

There is only one other possibility; to discover the name used by the alchemists themselves for the knowledge they sought. Such a name could have only signified the *secret of gold making*. In support of such a supposition I may quote from W. A. P. Martin's book, *Hanlin Papers*, 1880, p. 227, as follows: "Some find it in the mythology of the Greeks, maintaining—an interpretation older than the Christian era—that the golden fleece sought for by the Argonants, was merely a sheepskin on which was inscribed the secret of gold making. This construction of the legend comes from Dionysiun of Mitylene, who lived *circa* B.C. 50." The Chinese language, however, requires brevity and the condensed expression for the *Secret of Gold making* would be Gold-Secret, a term which, in classical Chinese, would again sound Chin-Mi, identical with the previous one meaning madness for gold.

The word secret, in Chinese, is Mi, as given in Mac Gillivray's *Dictionary of Chinese*, 1922, p. 599, and also in C. H. Fenn's *Pocket Dictionary*, 1932, p. 298. Unfortunately the word is also pronounced Pi and it is this sound which is mentioned in the *Chinese Dictionary* by Giles, 1892, character No. 8932. Pi is also its Cantonese pronunciation; so the term meaning Gold-Secret, in this dialect, would sound Kim-Pi which is phonetically different from Chemie.

The standard pronunciation Chin-Mi, meaning Gold-Secret, is also the one current in Ssch'uan. The Greeks would pronounce these words as Kin-Mi which, when freely spoken, would be easily converted into Kim-Mi and can serve as the ultimate origin of the word Chemie. This explanation would also apply to the other term Chin-Mi, meaning madness for gold. I do, however, believe that the term which was introduced into ancient Greece was

the one that reached there through the sea route for Canton represented a higher degree of culture than any inland centre up north.

I may further quote from Martin's *Hanlin Papers*, p. 230: "The Rev. Dr. Edkins in a paper on Taoism, published about twenty years ago, was the first, I believe, to suggest a Chinese origin for the Alchemy of Europe." With such a historical background the word Chemie acquires a connotative sense which is lost if it is not traced to the Chinese.

SUMMARY

Chemie can have two probable roots—Kim-Mi, Madness for Gold, and Kim-Mi, Secret of Gold.

Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
August 6, 1946.

1 *Curr. Sci.*, May 1946, **15**.

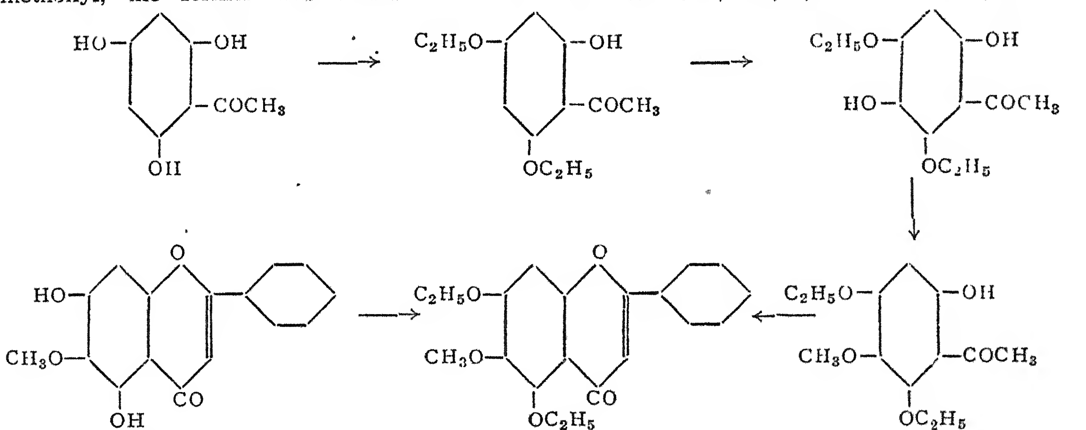
CONSTITUTION OF OROXYLIN-A

OROXYLIN-A was first isolated by Shah, Mehta and Wheeler[1] from the root bark of *Oroxylum indicum* and found to be a monomethyl ether of baicalein. In regard to the position of the methoxyl group the following points were taken into consideration. A hydroxyl group was resistent to methylation with diazomethane and this was placed in the 5-position. Of the other two alternative positions (6 and 7) for the methoxyl, the former was chosen since the substance did not give tests for the presence of ortho-dihydroxy grouping. Attempts to confirm this constitution by synthesis were unsuccessful.[2]

The preparation of the 7-methyl ether of baicalein has been recently reported by us;[3] its properties are quite different from those of oroxylin-A. Thus by elimination oroxylin-A should be the 6-methyl ether (I). Though the 6-methyl ether of baicalein could not be synthesised, it has now been possible to prepare synthetically a significant derivative of oroxylin-A providing positive proof regarding its constitution. O-Diethyl-oroxylin-A (m.p. 115-16°) is obtained by the ethylation of oroxylin-A using ethyl iodide and anhydrous potassium carbonate in anhydrous acetone medium. This is found to be identical (mixed m.p. undepressed) with 6-methoxy-5:7-diethoxy flavone which could be prepared by the new method of synthesis of 5:6:7-hydroxy-flavones and their derivatives recently described by Sastri and Seshadri.[4] The steps in the synthesis are indicated below:

Dept. of Chemistry, V. D. N. SASTRI.
Andhra University, T. R. SESHADRI.
Waltair,
July 30, 1946.

1. Shah, Mehta and Wheeler, *J.C.S.*, 1936, **591**. 2. —, *Ibid.*, 1938, 1555. 3. Sastri and Seshadri, *Proc. Ind. Acad. Sci. A*, 1946, **23**, 273. 4 —, *Ibid.*, 262.



(I) (II)

RACIAL CHARACTERISTICS

THE world is inhabited by a diversity of races. The origin of differentiation of mankind into such divisions is not known. Can climatic factors account at least partially for these differences? Experiments on isolated unstriated muscle support such a view (Singh, 1946). The optimum temperature for dog stomach varies with room temperature (Narayana and Singh, 1944). Similarly adaptation has been found in the tissues of the domestic fowl. Thus the optimum temperature for the œsophagus, which is more exposed, is lower than that for the duodenum; it is lower in winter than in summer. The optimum temperature for the testes in the human being would thus be lower than the tissues in the interior. The melting point of subcutaneous fat depends upon its distance from the exterior; this is to be correlated with the increase of temperature as the distance from the skin increases.

Such an adaptation would mean a redistribution of some factors in the tissues, for example ionic. This redistribution is bound to alter the characters of the individual. Similarly adaptation to diet, radiation is likely. Psychological characters may also play a part if nervous activity is accompanied by liberation of chemical substances or otherwise. There are thus bound to be differences between the English, the French, the Japanese, the Bengalees, the Punjabis, etc. Europeans dwelling in China may develop yellow characteristics if they live there as the Chinese do.

Dept. of Physiology, INDERJIT SINGH.
Dow Medical College, MRS. INDERJIT SINGH.
Karachi, M. C. MUTHANA.
May 25, 1946.

1. Singh, I., *Proc. Ind. Acad. Sci.*, 1946, **23**, 58.
2. Narayana, B., and Singh, I., *Ibid.*, 1944, **20**, 192

REVIEWS

Luther Burbank—A Victim of Hero Worship. By Walter L. Howard. (Waltham, Mass., U.S.A.: Messrs. Chronica Botanica Co.; Calcutta, India: Macmillan & Co., Ltd.), 1945-1946. Price 3.75 dollars.

This biographical sketch of the well-known "master-gardner, horticulturist and plant-breeder" Luther Burbank is authoritatively written by Dr. Walter Howard, Emeritus Professor of Pomology, University of California. Burbank's contribution to the building up of the reputation of California as the foremost Horticultural centre of the world has not been small in any manner of analysis. Nevertheless, the controversies that usually centre round great personalities have not been absent in the case of Burbank. Many men of pure science, Professor Howard says, had looked down upon the new varieties of fruit trees and ornamental plants that Burbank produced and even went so far as to say that they were merely imported from far off continents only to be renamed by the master showman Burbank. For instance, the Carnegie Institution paid a handsome annual grant of $10,000 for a period of five years and tried to get the scientific data and the entire story of the new hybrids that Burbank had claimed to have produced. For reasons not fully made known by the Carnegie Institution, their grant was suddenly withdrawn either because the scientific staff employed by them to act as *liaison* between Burbank and the progress of the science of Horticulture did not fully appreciate his work or because Burbank was not ready to divulge all his secrets. Whatever the reasons, a dispassionate and unbiassed judgement of the work done by this Horticulturist has now been written by Prof. Howard in this exceedingly fine publication. The reviewer was particularly attracted by the very genuine feelings of appreciation for Burbank's contribution to breeding better varieties of Horticultural plants expressed by the famous Dutch botanist, Professor Hugo de Vries. Other high lights of the book are Prof. Howard's narrative of the controversy of why Burbank's name was included in the list of scientists by the United States Post Office Department in 1940 when they decided to issue a three-cent commemoration BURBANK stamp. Among the illustrations, the reviewer was attracted by a charming photograph of the three practical men of America who were contemporaries in this century—Thomas Edison, Luther Burbank and Henry Ford. This picture was taken when Edison and Ford visited Burbank during the San Francisco Exposition in 1915 when Burbank was at the height of his fame.

The reviewer recommends this well-written book to all lovers of Horticultural development in this country. It brings out in excellent relief the one great quality of a practical plant breeder who with meagre fundamental scientific training, still felt it so necessary to give his best for the Nation's benefit. Particularly now, when the progress of Horticulture is in the threshold of great strides, honest practical men like Burbank would be a National acquisition.

T. S. SADASIVAN.

Geology for Engineers. S. Raja Raman, B.E., A.M.I.E. (Ind.). (College of Engineering, Trivandrum), 1946. Pp. 109. Price Rs. 4-8.

Professor Raja Raman being a Civil Engineer has taken considerable pains to bring out this small book on *Geology for Engineers*. The Engineers ought to feel grateful to the author for his attempt to present them with a useful book.

The book is divided into eight chapters: the first five deal with the General Principles of Geology, the subsequent two with portions connected with Engineering Geology, and the last with Economic Geology. While going through the text one finds lots of discrepancies which are bound to occur in a book written by one who has learnt the subject by himself. The author says that all that he has written are only things stated in other books. It would have added to the usefulness of the book if he had indicated the books in a Bibliography or as references. It is also felt that it would have been better if the author had taken the assistance of a Geologist in writing the book, rather than consulting the books himself. The discrepancies that I have mentioned are much too numerous for me to point them out individually. To speak of one or two, the author says that Microcline (p. 2) belongs to orthorhombic system. In p. 3, he gets confused between the habit of minerals and their crystalline forms. In p. 7, he places lava and the rock granite in the same category as rocks. In p. 19, he calls Magma as molten glass. In p. 31, while describing Mica-Schist the author makes it a character of this rock to contain fossil shells and corals. We find that the author is too ambitious to catalogue all the names in Geology without explaining them in their proper places. From the point of view of Civil Engineering Geology, it would be useful to refer here to Dr. Fox's book on *Civil Engineering Geology*.

At the outset whilst thanking the author for his book to the Engineering students, one would feel that its usefulness can be enhanced only when the author consults a man on the subject and brings it out on a more rational basis. I hope the author will kindly bear these suggestions while he brings out his next edition.

B. V. IYENGAR.

Records of the Department of Mineralogy, Ceylon—Professional Paper 2, 1944. Colombo, 1945.

This number of the Records contains two papers, one on "Ilmenite, Monazite and Zircon", by D. N. Wadia and the members of the Department of Mineralogy, and the other on "Gems and Semi-Precious Stones of Ceylon", by D. N. Wadia and L. J. D. Fernando.

Hitherto, the only source of information on the commonly occurring Ceylon minerals—

ilmenite, monazite and zircon—has been Sessional Paper VI, published in 1926 by the then Government Mineralogist, Mr. J. S. Coates. During these twenty years much new information regarding these minerals has been obtained, and so this authoritative publication on "Ilmenite, Monazite and Zircon", by the officers of the Department of Mineralogy is to be welcomed. In this paper, the original report by Coates has been thoroughly revised and brought up-to-date. Portions have been entirely re-written and several new analyses have been added.

Ceylon is famous for the abundance and variety of precious and semi-precious stones, for perhaps nowhere in the world are so many minerals of the gem variety concentrated in such a comparatively small area. The second paper on "Gems and Semi-Precious Stones of Ceylon" brings together much valuable information on this interesting subject. The geology of a typical gem field is first described, and then the origin of the gems and their association with the rock systems of Ceylon is discussed. An account is then given of the three methods commonly employed for winning raw gems from the ground. Next follows a systematic description of the gem species and varieties found in Ceylon. The paper concludes with a brief account of the methods used in cutting and polishing gem stones. The paper is illustrated by four plates, the first being a sketch map of gemming areas of Ratnapura District and adjoining regions. The other plates contain diagrammatic sections of gem-fields and gem-pits.

C. S. PICHAMUTHU.

Bulletin 34: *The Establishment and Early Management of Sown Pastures.* Pp. 210. Illustrations 93.

Bulletin 35: *The Forage Resources of Latin America—El Salvador.* Pp. 24. Illustrations 5.

These Bulletins are published by the Imperial Bureau of Pastures and Forage Crops, Aberyswyth, Great Britain, prepared in collaboration with the Bureau of Plant Industry, Soils and Agricultural Engineering, and the Forest Service, United States Department of Agriculture, Washington.

The Bulletins are of great value as contributing accurate and important information on the technique of grassland farming in temperate climates, embodying results of scientific experiments and trials, on farm-scale. The countries dealt with are: Great Britain, Canada, Australia, New Zealand, United States of America, with separate chapters for North Eastern States, South Eastern States, North Central Region, Central and Southern Region, Central and Southern Great Plains, North Great Plains, Intermountain Region and South Pacific Coast and Pacific North West Region. Bulletin 35 deals with forage resources of El Salvador in Latin America.

A comprehensive treatment of the subject under severe conditions imposed by varying climatic, geographical and economic aspects over such vast countries has been very successfully attempted, which redounds to the credit of the expert authors and for the method of collaboration at a high level. Practical details on field work, with meticulous care, are given on methods for pre-cultivation, preparation of seed-beds, sowings (even to depth to which each variety of grass seed is to be sown), after cultivation, manures and fertilisers and their placement, rotation and management. Such wealth of detail one often fails to see even in treatises on Indian economic crops.

The Bulletins are profusely illustrated: Bulletin 34 containing as many as ninety-three, which add to the clear understanding of the subject and help appreciation of the types of country each author deals with.

It would only be accentuating the positive if one is tempted to draw the attention of the departments of Agriculture in general and the departments of Animal Husbandry in particular, in India, to the failure, so far, to present any comprehensive literature, much less practical demonstrations on farm-scale, on this most important subject of grass farming. The ever increasing demand for better and more milk not to speak of necessity for livestock improvement in general, is considered to have been met by growing a few well-known grasses like Guinea grass, Rhodes grass, etc., on an agricultural scale to feed the dairy animals in a few well-run dairies. India comprises a wide range of geographic, climatic and economic conditions and so do the varieties of grasses and their growing resources. If national India is to move into direct action to improve its cattle wealth and its food problem the only way, as shown by Great Britain, Canada, America, etc., is to set about practising the technique of grassland farming on the results of broad-based scientific investigations and not to trust, as now, to turning the cattle on to village *Gomals* for grazing, with disastrous results.

K. M. G. RAO.

SCIENCE NOTES AND NEWS

History of Survey of India from Earliest Times to Present Day.—A history of the Survey of India in a series of volumes, entitled "Historical Records of the Survey of India", is being published by the Surveyor-General of India. This series, the first volume of which covering the eighteenth century has now been issued, is being collected and compiled by Col. R. H. Phillimore, formerly of the Survey of India. It is designed to give a full detailed account of the work of the surveyors and geographers of India, and has been prepared from official records of the department, of the Central and Provincial Governments, of the India Office and also from records of the British Museum.

These Records reconstruct the history of surveys in India from the earliest days of their

inception and simple beginnings in the 18th century and aim at bringing it up-to-date.

The first volume of these Historical Records describes the work of the 18th century, "a period of romance and adventure".

The second volume will deal with the period (1800-1815) of the historical development of Indian surveys, when regular organisation and system was brought to the topographical surveys of the Madras Presidency by Colin Mackenzie and the foundation of the trigonometrical survey of India was laid by William Lambton.

The third volume will cover the period (1815-1830), when all the surveys were co-ordinated under one Surveyor-General of India and Lambton's trigonometrical survey of the South Peninsula was extended as framework for the geography of the Continent at that period. A Revenue Survey Department was established to provide professional control for such surveys, and the great Atlas of India was started to cover the whole of India with a continuous map on a uniform scale.

Indian Aluminium Industry.—The Aluminium industry, a war-born industry, has made spectacular developments during the past three years, and India has now a prominent place among the world producers of aluminium. It is the only non-ferrous metal of which, so far as is known, India possesses large deposits. Rapid developments are taking place in the manufacture and utilisation of this metal.

The year 1943 saw aluminium produced for the first time in India at the Alupuram (Travancore State) Reduction Works of the Indian Aluminium Company. Since then, spectacular developments have taken place. The whole of the war-time requirements were supplied by the Indian Aluminium Company. The rolling mills in Belur, Calcutta, and the manufacturing plants produced sheet metal, and components for aircraft parts, radio and field telephone equipment, range finders, field hospital equipment, etc. From a technical point of view, production operations in the Travancore factory compare favourably with the large production units in Canada and the United States of America. Carbon electrodes required for aluminium reduction are produced in the Works. Arrangements are complete for the production of strong alloys of the duralumin type. The Travancore factory will produce, when its power requirements are fully satisfied, 5,000 tons of aluminium per annum. The construction of the Aluminium Works for the treatment of Indian bauxite at Muri (Bihar) is nearing completion. This factory will have an ultimate capacity of 40,000 tons per annum. The Aluminium Corporation of India, Asansol, has now started working and produces at present about 1.000 tons of aluminium a year. This production will be stepped up shortly.

"Curare to Aid Anæsthetics.—To see whether curare, a deadly poison with which South American Indians tip their darts and arrows, could be used to make anæsthetics safer in operations, Dr. Prescot, Director of Clinical Research at Wellcome Research Institution, allowed himself to be poisoned by it.

His chief collaborators were Dr. Geoffrey Organe and Dr. Stanely Rowbotham, two of the most skilled anæsthetists in England. They described Dr. Prescott's experiences as terrifying. An injection of curare paralysed him; he was unable to speak, swallow, cough or move. When paralysis stopped his breathing, he was revived by artificial respiration. In six hours he had recovered and there have been no after-effects.

Dr. Prescott said: "I knew unconsciousness was coming over me, but I was unable to give any sign. I tried and failed. We have learned a great deal. Properly administered, Curare and its derivatives will prove a great aid in anæsthetics and eliminate many post-operative complications."

Scientist's Plan Against Tse-tse Fly.—Mating calls of tse-tse flies are being recorded on gramophone discs by Mr. F. L. Vanderplank, a biologist engaged in research at the Bristol University on behalf of the Tanganyika authorities devoted to neutralising the scourge of sleeping sickness. Mr. Vanderplank has discovered that the flies send out mating calls by vibration of the wings. By producing an artificial mating call he believes that flies of different species could be induced to mate. The hybrid offspring would be sterile. False calls on a large scale would bring out so much cross-breeding and consequent sterility that the tse-tse fly would become extinct.

Flying Display.—Visitors from all parts of the world will be invited to Great Britain in September to see the Flying Display and Exhibition organized by the Society of British Aircraft Constructors at the Handley Page Aerodrome, Radlett, Hertfordshire. Six such displays were organized by the S.B.A.C. each year from 1932 to 1937.

Two hundred British companies—manufacturers of aircraft, aero-engines, propellers, instruments, components, materials—will show their products. The Society's guests will be shown modern types of commercial and combat aircraft, and the latest power plants, both piston and gas-turbine units. The entire display will cover an area of more than two acres.

For two days—September 12th and 13th—this display will be open to the invited visitors, who will be able to get at first hand a complete review of British aircraft and aviation products. On the second day, there will be a flying display by record-breaking jet propulsion fighters, bombers, and the several new types of civil transports which have come from the British factories since the end of the war.

ERRATUM

In *Current Science*, June 1946, p. 162, *in place of* "Table II shows the effect of changing the inlet acid concentration of nitrobenzene on $K_N a$ and $(H.T.U.)_{ON}$." *read* "Table II shows the effect of inlet acid concentration of acid solution and the influence of extraction height on $K_N a$ and $(H.T.U.)_{ON}$."

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CURRENT SCIENCE

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NATURAL PRODUCTS OF THE EMPIRE*

"THE natural products of the Empire and the chemical industries that are or might be based on them" was the subject of discussion at a meeting of the Empire Scientific Conference which was presided over by Dr. J. L. Simonsen, Senior Research Scientist in the Colonial Office. The Conference decided that research on the utilisation of raw materials should be regionalised as far as possible in view of the shortage of scientific man-power in the Empire and recommended the formation of a central board of representatives of the Dominions, India, the Colonies and the United Kingdom to co-ordinate and guide research on the utilisation of the natural products of the Empire.

Sir J. C. Ghosh and Dr. D. N. Wadia presented a paper on "A Survey of Indian Chemical Industry in relation to Raw Materials and other existing Industries of India". The raw materials available, the scope and extent of the existing industries and their war-time developments, were surveyed and suggestions made for expansion of the following industries:—manufacture of chemicals, textiles, soaps, leather, paper, sugar, glass and ceramics, paints and varnishes, drugs, rubber goods, hydrogenated oils, synthetic fertilisers and insecticides. Most of the raw materials for the chemical industry are available in India. In the production of ilmenite, monazite and beryl, India holds a strategic position. In view of the large imports of petrol the fullest use must be made of benzol, now being produced from the high temperature coke ovens which may yield three million gallons if the recovery of the entire product is encouraged by the Government by fixing a fair selling price. The possibility of low temperature carbonisation of coal with a view to secure larger yields of ammonium sulphate, soda ash and phosphatic fertilisers in South India may possibly be established based on the local production of sea-salt, phosphates and gypsum of Trichinopoly and limestone of Tuticorin. India's resources of sulphur are poor; Surveys of Baluchistan sulphur deposits were disappointing and small deposits of pyrites are not dependable. Government can put up a small factory which will yield valuable data on the economics of sulphuric acid production from gypsum whose deposits in India are extensive and of high grade. Construction of a factory for producing 350 thousand tons ammonium sulphate using gypsum from N.W. India has been started and another factory with a capacity of 50,000 tons per annum is under construction near Cochin harbour using the gypsum of South India. Negotiations have been completed by the Tatas for starting a dystuff industry in India on a comprehensive scale in collaboration with the Imperial Chemical Industries. If the proposal for prohibiting export of ilmenite and monazite sands materialises, it is probable that industries based on these raw materials may be soon started in the Travancore State. Production of aluminium electrolytic copper, electric furnace steel, alloy steels, ferrochrome, ferrosilicon, etc., which was started on a small scale during the war will probably undergo rapid expansion in view of an assured market within the country itself.

In a paper entitled "Natural Products of the Empire and their utilisation", Dr. J. L. Simonsen considered the utilisation of natural products of the Empire from colonial aspects. The products may be divided into two classes —mineral (wasting) and agricultural and forest

* Review of Proceedings of the Empire Scientific Conference held in London, July 1946.

(growing) assets. In their utilisation water is of fundamental importance and an adequate survey of the water resources of the Empire is essential as man, stock and crop depend on water which also supplies power and heat when suitably sited. This important aspect of the future industrial development has been fully recognised in India which has remained a pioneer in the study of problems of irrigation. Consideration might be given to the processing of the mineral ores, *viz.*, bauxite deposits of the Gold Coast and British Guiana in the Colonies themselves as is being done in the Dominions and India. Rich ores of metals like lead and tin are being rapidly exhausted and a fruitful field may lie in the prospecting for new sources of low-grade ores and finding improved methods for their utilisation: The prosperity of the Colonial Empire depends on the efficiency of its main industry, namely, agriculture, which requires to be maintained at a high level. There is considerable scope for the introduction of improved methods in the treatment of sugarcane and new industrial uses for sugar must be found out apart from its uses for nutrition and in fermentation industries. It is essential to re-examine the main starch yielding plants for the difference in the character of the starches as recent researches on the separation of the two constituents of starch suggest new technical uses. Use of alcohol as a motor fuel must be encouraged. Fermentation industries which use molasses as the raw material may also be of importance. Working up oil seeds in the colonies exporting only the oil and using the cake locally, should be investigated. Afforestation of suitable areas with pines might provide valuable Empire sources of turpentine and rosin. Manufacture of vanillin from lignin and guaicol endangers zanzibar clove oil industry and it is urgently necessary to find new uses for the clove oil. Development of minor forest products like lac, cashew-nut oil, gums, insecticidal and medicinal plants should be undertaken. The fruit industry could be encouraged and greater attention paid to the possibilities of industries based on livestock and fisheries.

Prof. E. J. Hartung dealt with the utilisation of some of the natural products of Australia excluding minerals and coal. The average annual Australian clip of wool contains about 80,000 tons of wool-wax and 30,000 tons of suint. In the wool scoured in Australia at present, 15,000 tons of wool-wax are potentially available out of which only 450 tons are saved and the associated 5,000 tons of suint are wholly lost. A thorough investigation is being undertaken to find other uses for these bye-products of the wool industry. Wool-waste itself can be used as a raw material to produce protein hydrolysates, synthetic fibres, plastics or fertilisers. Trees of the genus eucalyptus are predominant in Australia and Tasmania and are capable of yielding large amounts of wood-pulp, lignin and eucalyptus oil. Methods can be developed for obtaining good yields of pulp and furfural from wheat straw which at present, is being used to produce semi-chemical pulp for straw board. Oat hulls, cotton-seed hulls, maize cobs, and hard wood saw dust can be utilised for making furfural. Most of the sugar produced in Australia is used as food. Apart from its use as a source of alcohol there may not be much scope for expanding the use of Australian molasses for making solvents. The outlook on sugarcane wax is not promising. Large quantities of bagasse which are, at present, being used for making light wall-boards and for the generation of power, may possibly be used to provide long-fibred pulp for mixing with short-fibred pulps from Australian hard woods. Fellmongery trimmings are processed to recover the wool and for making glue and gelatine. Processing of offals for animal feeds and organic manures, have been established and production of shark-liver oil rich in vitamin A has reached good proportions. Full potentialities of Australian fisheries are not known, but air surveys have given promising indications; development must, however, proceed on lines different from those which have been successful in European waters. During the war investigations showed that a number of coastal weeds of Australia could be used for agar manufacture and in particular *Gracilaria confervoides* from New South Wales waters might furnish a 50 per cent. yield on the dried weed basis. The present annual output of 24 tons agar could be increased to 100 tons. There is also the possibility of establishing the manufacture of alginates from the weed macrocystis in view of the varied uses to which the alginates were put during the war.

"Review of some Natural Products of the Union of South Africa and the Industries that are or might be based on them", contributed by Dr. H. J. Van Eck, gives a survey of the raw materials available in South Africa. The best basis for developing resources is to direct all productive effort in accordance with the country's comparative advantages. The mineral resources are discussed with particular emphasis on iron, manganese and chromium ores, with the developments that have already been made in the iron and steel industry the production of stainless steels may be of importance because of the Union's favourable position. The large and cheap deposits of coal in the Union, which form the source of electricity, should in future play an important part as a raw material in the chemical industry and also become potential oil fields. The fact that some exotic trees grow faster in South Africa than in most other countries whose chemical industries are used on the sugar industry, underlines the possibilities of masonite, paper and cellulose if adequate water-supplies can be made available. There are also possibilities of developing cotton and woollen textiles. The Union has some great natural advantages but is deficient in some other directions; yet greater all-round progress can be made if a closer collaboration with other African territories in the matter of an interchange of materials can be established.

D. V. James Melville discussed the natural products (biological) of New Zealand and the chemical industries that are or might be based on them. Butter and cheese account for over 50 per cent. of the value of New Zealand's exports. Even though chemical methods of control are used on these industries they can-

by no means be termed chemical industries. Attention must, therefore, be directed to the by-products of butter and cheese manufacture, *viz.*, skim-milk and whey and their utilisation in special ways. Not more than 5 per cent. of the total skim-milk produced in New Zealand is dried, the rest being used as pig feed. Efficiency of conversion of milk solids into pig flesh is low and high-grade proteins are wasted in the process. The technical problems of utilising skim-milk are connected with dehydration and storage which will allow of entirely satisfactory reconstruction, marketing in areas of low purchasing power with the best methods of addition to the protein-poor diets of such areas. Uneconomic utilisation of whey also leads to a large overall loss of high-grade proteins. The New Zealand process of manufacturing lactose from whey is technically efficient. Due to the expansion in the world market for lactose during the past three years, largely in connection with the manufacture of penicillin, the present prospects for the industry appear bright. The concentrated mother liquor left over after recovering lactose are now used entirely as stock feed. Nothing promising has emerged from the work done towards a more economic utilisation of this product. Production of casein from skim-milk is strictly controlled due to the demand for pig meat by the United Kingdom and the consequent necessity for retaining skim-milk for pig feeding. Casein is likely to hold its own as an adhesive in plywood manufacture and while there is a field for some expansion in casein plastics there is a constant threat from synthetic resins and plastics. Among the by-products of the meat industry prospects for rennet production in the post-war period are encouraging and the current economic policy furnishes the leather and hides industry an assured internal market. A sound gelatin industry which is now operating, can offer adequate supplies of raw glands, particularly the pancreas and the pituitary, for the preparation of hormones in New Zealand itself. A more economic use of blood than its conversion into fertiliser is a major piece of investigation in which New Zealand is particularly interested. Fish liver oils and sea-weed products such as agar and alginic acids appear to have real potentialities. Tree growth in New Zealand is rapid and her exotic forests can be greatly extended. More efficient utilisation of the products of the timber and pulping industries is an urgent problem facing New Zealand in common with all timber producing countries of the world and justifies considerable expenditure on research work. In view of the natural advantages possessed by the New Zealand flax plant, *Phormium tenax*, in high fibre yield per acre, intense investigation on the plant and its fibres which have been hitherto sporadic, is fully warranted. The phormium fibre cannot be utilised for rayon manufacture but a high-grade paper can be made from it. The small tobacco industry of the country provides enough waste material and there seems no reason why about half of the country's needs of nicotine should not be obtained from locally grown tobacco. The wartime enterprises of successfully growing on small areas *Digitalis purpurea*, *Dattura stramonium*, *Belladonna and Hyoscyamus* for home consumption and foreign export, deserve to be consolidated during the post-war era, since inquiries for further supplies of the drugs have been received from both English and Australian firms.

ON PHYSICAL ANALOGY—ITS USEFULNESS AND ITS DANGERS

By D. Ferroli, s.j., d.sc.

Introduction

Curiosity is the beginning of Science. Curiosity leads to *observation*, which studies facts, follows their development, inquires into their origin. After observation comes *classification*, whereby facts are arranged into various categories, according to their similarity or otherwise. A third step may be described as *formulation*, when the *law*, which is suspected to underlie the uniformity with which facts present themselves, is given a succinct verbal shape, to be—whenever possible—expressed by a mathematical formula. But the formula is—by its very nature—universal, and must be verified; *i.e.*, formulation demands *verification*, which is obviously done by further observation and experiment.

2. The Main Scope of Analogy in Physics is Explained by Means of an Example

To guide the physicist to develop his ideas, without committing himself to a definite theory, *Analogy* plays a most important part. By *Physical Analogy* we understand—with Clerk Maxwell—"that partial similarity between the laws of one science and those of another, which makes each one of them illustrate the other".

When the study of *Solutions* was first undertaken, and the main facts observed and classified, it became soon apparent that the solute existed in the solvent in most minute particles, which seemed to be in continual agitation. The question was soon asked: May not these particles behave in the solvent, as the particles of a gas behave in a closed vessel?

If that was so, the *Kinetic Theory of Gases*, so magnificently built up by the genius of Clausius, Maxwell and Boltzmann could perhaps be used to illustrate the behaviour of solutions. The suspected *Analogy* might also, eventually, lead to the discovery and formulation of a law. Now the first formula of the Kinetic Theory embodies the Laws of Boyle-Mariotte and of Charles. Could a similar formula be applied to solutions?

As is well known, Pfeffer found that, in the case of dilute cane sugar solutions the osmotic pressure, at a given temperature, is nearly proportional to concentration. Also, the osmotic pressure, for a given concentration, is proportional to the absolute temperature.

This, of course, means that the Laws of Gases hold also for dilute solutions, and Van't Hoff left justified in asserting that the osmotic pressure of a solution is equal to the gas pressure which the solute would exert if all the solvents were removed, and the dissolved substances were left in the space in the condition of an ideal gas.

In this case similar, or analogous behaviour was first suspected. Experiment proved the suspicion to be correct. But it was Analogy which dictated the experiments, and showed the path which the scientist had to choose among an infinity of alternatives, if he was to put some order in his notions of solutions, and formulate some Law which might be a convenient indication of their behaviour.

3. A Remark

But in this way. did not Analogy limit the scientist's vision, and lead to forced conclusions?

Obviously it did limit his vision; but, paradoxically, it is only by limiting our field of view that we achieve success. A scientist, who attempts to embrace all, will grasp nothing. There is no concentration without limitation, and by concentration we gain in depth, if we loose in extension. Further, orientation imposes limitations: but research lacking orientation will prove futile.

4. A Danger

But might not Van't Hoff's bold formulation prove deceptive? Might not similarity of terms cover very dissimilar things? The possibility cannot be denied, and it appeared very real as soon as scientists tried to identify osmotic pressure with the molecular bombardment by the particles of the solute. Besides, an Analogy was asserted between the solvent and an empty vessel. But how can a solvent be assimilated to a vacuum? Are the interstices between the particles of the solvent so great in comparison with the molecules of the solute, as to allow a certain plausibility to the view that the behaviour of particles in dilute solutions is analogous to the behaviour of gaseous particles *in vacuo*?

Yet Boltzmann showed that, on the assumption that the *Law of Equipartition of Energy* holds for the solute, the laws of osmotic pressure necessarily followed. But scientists were somewhat suspicious of Boltzmann's mathematical methods as applied to solutions, for, in the words of Clerk-Maxwell, "the excessive use of Mathematics in Physics may make us lose sight of the phenomena to be explained; and though we may trace out the consequences of given laws. we can never obtain more extensive views of the connexions of the subject".

It is good to remember that mathematics—as applied to physics—systematizes, summarizes, simplifies, but does not, by itself, lead onwards. Progress is mainly due to Experiment and to Analogy.

5. Another Example

And Analogy led on Jean Perrin to study *Emulsions*, and see if the *Law of Equipartition of Energy*, which is the corner-stone of the Kinetic Theory, might hold for them also. Pfeffer had shown that a molecule of sugar, with some 40 atoms, acts like a molecule of hydrogen with only 2 atoms. Perrin went further, and surmised that there was no limit to the grouping of atoms, and that the law holds also when groups are so complex as to be visible to the microscope. Then, of course, a corpuscle, which takes part in the so-called *Brownian Movement*, and which consists of millions of atoms, ought to behave like a hydrogen molecule. If it is so, *Emulsions* obey the Laws of Gases, and it must be possible to determine *Avogadro's Constant* from their behaviour. Perrin's wonderful experiments led him to the determination of that very important number, his results lying between $60 \cdot 10^{22}$ and $70 \cdot 10^{22}$. A remarkable achievement indeed.

6. Caution

We shall digress a little, though, as it will be seen, the digression has a certain bearing on the matter in hand.

All will admit that there exists an Analogy between a map (say) and the country which it represents. From the map one can find distance, direction and orientation between two places. The map will tell us whether a district is hilly or not, wooded or cultivated, rich in water or rich in sand. Yet, how different is the knowledge of a country which we gather from a map, and the knowledge we acquire by visiting it. Map-knowledge—so to call it—is not to be despised, but it lacks life and fulness. Map-knowledge is not false; yet how poor and meagre, if unaccompanied by real knowledge.

The same may proportionately be said of the knowledge of one science gathered only from the Analogy with the Laws and formulæ of another science. The formulæ need not be false, but the knowledge they impart is meagre and inadequate. It must needs be filled up and implemented by experimental knowledge. The beginner is always under the danger of resting content when, either by Analogy, or by the free use of Hypothesis, or in some other way, he has given mathematical expression to a Law. To take an example from Clerk-Maxwell: "The Laws of uniform motion of heat in homogeneous media are mathematically identical with those of attractions varying inversely as the distance. Hence, if we knew nothing more than is expressed in the mathematical formulæ, there would be nothing to choose between one set of phenomena and the other". Similarly the Laws of Gases, of dilute solutions and of emulsions, are analogous. The formulæ which represent them are the same. Yet the difference is considerable.

7. A Third Example

As already remarked, *the Law of Equipartition of Energy* is the foundation of the Kinetic Theory of Gases. By a stroke of genius, Eddington extended the Law to the stars. Already in 1911 Halm had suspected a certain equality between the kinetic energies of light and heavy stars In 1922 Seares showed that the surmised equality was real. Eddington then studied the problem of the distribution of density, pressure and temperature in the interior of a star. The forces coming into play are gravitation and the pressure of radiation. Observation furnished the data of mass, density and quantity of heat radiated by the star

in unit time. Owing to the exceedingly high temperatures and to the so-called *Photo-Electric Effect*, the atoms in the stars are dissociated and ionised. Now, by Analogy with perfect gases, the Thermo-dynamical Theory of Gibbs on the equilibrium of gaseous systems may be applied to the electronic dissociation in the stars. Eddington then worked out the formulæ which connect the mass of a star with its radius, its temperature and the quantity of energy which it radiates. For instance the temperature at the centre of the Sun is $4 \cdot 10^7$°C. and its pressure, $133 \cdot 10^7$ atmospheres. He found also that if the mass of the star is less than 10^{32} gms. the radiation pressure is very small in comparison with that due to matter. On the contrary, if the mass exceeds 10^{35}, the material pressure may be neglected. From astronomical data he constructed his famous *Curve*, which afforded a sufficient test for his theory. But it proved something more.

In the beginning it was believed that Eddington's theories, founded as they are on the Laws of perfect gases, applied only to giant stars. For it seemed inconceivable that the Laws of Boyle and Gay-Lussac could be valid for stars with a density several times that of iron in their interior. But observation showed on the contrary that the properties of gases are to be applied to all the stars (*f.i.*, to *Capella*, whose density equals that of air, and to *Krueger*, sixty times as dense as iron). The thing was astounding. How an explanation was sought and found in the new ideas on the constitution and disintegration of atoms is most interesting, but it far exceeds the limits of the present article.

8. Conclusion

What has been said, however, is sufficient to show the fruitfulness of *Physical Analogy*. By *Analogy*, not only does the scientist systematize his knowledge; he further extends and develops it. *Analogy*, by suggesting the formulation of a Law, will direct the choice of experiments. No doubt, an injudicious use of *Analogy* may lead to a distorted view of nature. Also, merely analogical laws may result in knowledge that is formal and almost nominalistic. Experiment, however, will keep our feet firmly planted on Earth—which will eventually prove to be a spring board enabling the mind to fathom the innermost secrets of the stars.

TONUS IN STRIATED MUSCLE

By INDERJIT SINGH, F.A.SC., AND MRS. SUNITA INDERJIT SINGH

(From the Physiological Laboratory, Dow Medical College, Karachi)

THE mechanism by which a state of partial contraction of striated muscle, or tonus, is produced remains enigmatic. The explanation most generally accepted is that a rotational excitement of motor units occurs, one group being released as the next contracts.[1] The excitations would have to be properly timed in order to produce an even and imperceptible contraction as that of tonus. If this were true it would be expected that action potentials led from small aggregates would reveal rotational bursts of impulses. Such a phenomenon has not been capable of demonstration.[2]

Light on the tonic contraction of striated muscle is thrown by studies of similar contraction in unstriated muscle. The chief characteristics of tonic contraction of skeletal muscle are: (1) The metabolism (oxygen consumption and carbon dioxide output) is low when compared with that of muscle when executing movements; it is only about 25 per cent. higher than that of completely paralysed muscle. Posturing muscle is also relatively infatiguable; the deverbrate cat may stand for six days without signs of exhaustion. A small (needle) electrode placed into a muscle unit, shows that it contracts synchronously but responds at a low frequency, *i.e.*, 5-20 per second indicating a correspondingly low rate of discharge from the anterior horn cells.[3] The tension exerted is far smaller than that given by the same muscle when it is stimulated at a high rate (*e.g.*, 100 times per second) through its motor nerve.

Skeletal muscle contains red fibres, rich in sarcoplasm, poorly marked transverse striations and nuclei scattered throughout the substance of the fibres. They contract slowly after a long latency, the duration of contraction being three times that of the more quickly acting and more highly differentiated pale fibres. Red muscles go into tetanus at a low rate of 5 to 8 stimuli per second.[4]

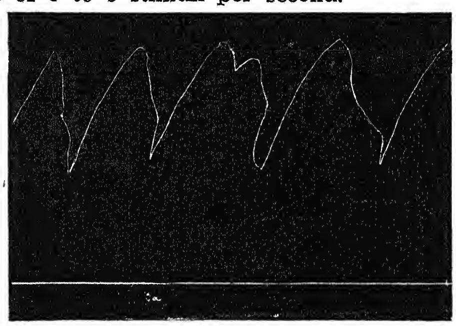

FIG. 1. Mytilus muscle in saline with 0·02 M Ca l_2; Barium 0·07 M Ba Cl_2

Now, let us compare the above facts in striated muscle with those in unstriated muscle. Unstriated muscle can be tetanised if stimulated at a much lower frequency than striated muscle; various unstriated muscles in the body may differ in this respect, just as red and pale skeletal fibres. The metabolism of tonic contraction is lower than that of twitch contraction.[5] If *Mytilus muscle* is

immersed in a solution containing barium, it passes into a tonic contraction which is maintained by the muscle contracting periodically. Barium, though continuously present in the saline, appears to produce an intermittent stimulation. An interesting feature is that the frequency of stimulation automatically adjusts itself depending upon the slowness of relaxation; as expected the frequency is less, the slower the relaxation. Further the state of the muscle can be changed by varying the calcium concentration of the saline. If the concentration of calcium is high, then the relaxation is more rapid and the frequency greater than if the calcium content is low (Fig. 1).

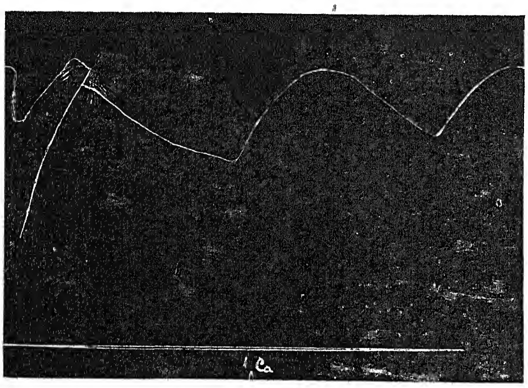

FIG. 2. Same muscle in 0·01 M $CaCl_2$

If the muscle is contracting at a low frequency, it is practically unfatiguable. Thus for tonic contraction, stimulation at a low frequency is required.

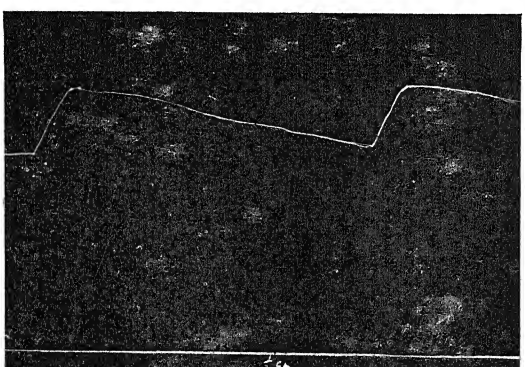

FIG. 3. Same muscle in 0·005 M $CaCl_2$

The above experiments on unstriated muscle show phenomena of tonic contraction which are very similar to those in striated muscle, and suggest that the tonic contractions in the two kinds of muscles are similar. The explanation which has been suggested for the former would, therefore, also apply to the latter.[6] It is probable that in striated muscle the same fibres subserve both twitch and tonic contractions, though differentiation has occurred into

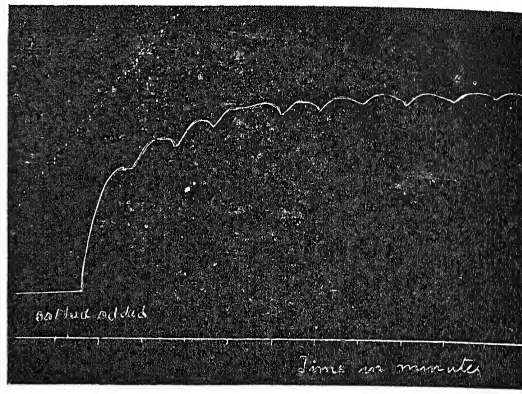

FIG. 4. Another muscle in 0·01 M $Ca\,Cl_2$

red and pale fibres in skeletal muscles, just as it has occurred in muscle in general into striated and unstriated ones. By some action it is probable that the state of skeletal muscle fibres is varied when they have to contract tonically or quickly. That isolated skeletal muscle is always in a state of partial, though minute contraction has been shown recently.[7] There is no reason why there should not be a variation in the magnitude of this contractile state. The twitch and the tonic contractions may be part of same contraction "spectrum"; as shown, the contractions of cardiac muscle would also fit into the same spectrum.[8] The various components of this "spectrum" may be linked as follows, though there may be some overlapping.

Striated muscle of insects (about 300 contractions/sec.,→ slower striated muscle of other animals; pale fibres in twitch contraction (about 100/sec.) → pale fibres in tonic contraction (about 20/sec.) → red fibres (about 10/sec.) → cardiac fibres (about 70/min.) → quickly contracting (about 2/min.).

Unstriated muscle → tonic contraction of some unstriated muscle (about 1/10 min.) → tonic contraction of extremely slowly contracting unstriated muscle (about 1/30-60 min.).

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TUBERCULOSIS IN INDIA*

THE Seventh Annual Report of the Tuberculosis Association of India for the year 1945, records another year of its useful work for the prevention, control and relief of tuberculosis in India. The factors which have hampered the progress of work of the Association since its inception still continue, but with the cessation of the war, it is hoped that considerable amount of energy which was so far mobilised in the country's war effort will now be diverted towards fighting the menace of India's "public enemy No. 2", tuberculosis.

In spite of all the difficulties that stood in the way, the Association, during the year under report, has been able not only to consolidate the work already started, but also to make considerable progress in new directions. There are at present 124 tuberculosis clinics and 70 tuberculosis hospitals and sanatoria with a total of 4,384 beds. The Government of Bengal is contemplating the opening of two tuberculosis sanatoria of 500 beds each in the Presidency. It is expected that the Government of Bombay and Bombay Municipality will complete two more clinics in near future. A tuberculosis sanatorium is being constructed at Ranchi by the Marwari Relief Association, Calcutta.

Under the auspices of the Central Association, Post-Graduate Refresher Course has been organised in different parts of the country. Two such courses were organised in Lahore and Madras during 1945; 32 doctors in all have received post-graduate training. It is the intention of the Association to organise similar courses at frequent intervals. Training of Health Visitors has also been undertaken. The course which commenced in October 1944, terminated in June 1945. Out of seven candidates who received instructions, four have been successful. Twelve candidates are, at present, receiving training. So far, New Delhi Tuberculosis Clinics and Lady Linlithgow Sanatorium, Kasauli, had been giving such training; but it is hoped that other affiliated associations will arrange in due course, to train this class of workers within their own provinces. The Association has also continued to afford training to a limited number of doctors at the Lady Linlithgow Sanatorium and New Delhi Tuberculosis Clinics. The Association has also decided to take suitable candidates at the Lady Linlithgow Sanatorium for training in the field of nursing.

The Madras Tuberculosis Diseases Diploma Course continues to be popular. The Mysore T.D.D. Course was started in June 1945 and it is expected that the Calcutta University will institute a similar course in the near future.

Dr. P. V. Benjamin has acted as Technical Adviser throughout the year and has devoted a considerable portion of his time to the affairs of the Association. He undertook an extensive tour in Western and Northern India and visited several centres to tender expert advice.

The full development of the Publicity and Propaganda Section has unfortunately been hampered to a great extent, but it is hoped that with the end of the war, more facilities will be available for the expansion of this section. In the meantime activities were carried on, by means of pamphlets, charts and other useful materials. Regarding the outlet for scientific papers on the subject, the Association has been labouring under serious handicap. *The Indian Medical Gazette* had been publishing Special Tuberculosis Number for the past eight years, but there are now difficulties in the continuation of this arrangement. The Association feels that at this stage, it should have a journal of its own, and it is expected that a journal predominantly of a clinical nature will be started after the next conference of the tuberculosis workers.

During the year under review, the Lady Linlithgow Sanatorium has carried on very useful work. The increasing progress and success of the Sanatorium can be judged from the receipt and payment account which appears in the Appendix. The activities of the New Delhi Tuberculosis Clinics in 1945, as in the previous years, represent a stage in the development of the propaganda, treatment and survey method of control of tuberculosis. The Clinics continued to function as a demonstration centre for diagnosis, treatment, care and after-care of patients, educative and preventive activities in the tubercular homes and a training centre for tuberculosis workers. Summaries of the reports of the Provincial and State Tuberculosis Associations appear in Appendix IX. The reports show that these Associations have concentrated their efforts on the training of tuberculosis workers and anti-tuberculosis propaganda and that a uniform progress has been maintained throughout the year.

N. N. DE.

* Seventh Annual Report, 1945—The Tuberculosis Association of India. (Published by the Tuberculosis Association of India, New Delhi.)

V-2 ROCKETS TO RECORD SUN'S ULTRAVIOLET RAYS

FILMS developed by Eastman Kodak Co. with special fluorescent coatings will be used in spectrographs mounted in the noses of V-2 rockets. Ultraviolet sunlight, unable to penetrate either our atmosphere or ordinary photographic emulsions, will be recorded when the rockets reach altitudes of about 100 miles. The fluorescent film coating glows when ultraviolet light strikes it, and the glow is recorded on the film.

—(*Courtesy of "Sky and Telescope,"* August 1946, p. 10.)

LETTERS TO THE EDITOR

GEOMAGNETIC TIME VARIATIONS AND THEIR RELATION TO IONOSPHERIC CONDITIONS

Besides the secular variation of the geomagnetic field there are other time variations of which, for equatorial stations the solar diurnal variation is the most important which is believed to originate in the earth's outer atmosphere or in the Ionosphere. The quiet day solar diurnal variation S_q is generally derived from the records of the five International Quiet days per month. From a comparison of these curves for different observatories it is possible to study the variation of the Ionospheric currents with the geographical and geomagnetic co-ordinates. It is believed that the S_q variation depends on geographical latitude and local time. The purpose of the present note is to show that, whereas this may be true for stations in high latitudes, the S_q curves for stations at low but equal geographical latitudes, differ widely both in intensity as well as in type. In Fig. 1, I have drawn the average S_q curves of H for Alibag ($\phi = 18 \cdot 6$, $\lambda = 72 \cdot 9$, $\psi = 9 \cdot 5$) for the equinoctial season, for the years around the sunspot maximum (1926-1929), where ϕ, λ, ψ are the geocentric latitude, longitude and the geomagnetic latitude respectively; together with the similar curves for San Juan ($\phi = 18 \cdot 4$, $\lambda = 293 \cdot 9$, $\psi = 29 \cdot 9$) and Huancayo ($\phi = -12 \cdot 0$, $\lambda = 284 \cdot 7$, $\psi = -0 \cdot 6$) as given by Bartels[1] and others. S_q curves also

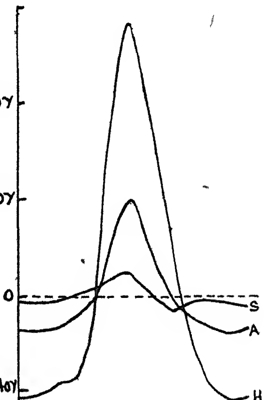

FIG. 1. Average S_q curves for San Juan (S), Alibag (A) and Huancayo (H).

vary with season and sunspot number, the variation, however, occurs in intensity, but the

type is more or less similar. This was also shown by Moos[2] from an analysis of the Bombay records for the years 1894-1904. It appears that the diurnal range at Alibag is about *four* times that of San Juan and the types of the curves are also dissimilar, and in particular the evening sharp minimum at San Juan, which falls below the mean night level, is not at all visible at Alibag. When compared with Huancayo it is evident that the S_q curves at Alibag and Huancayo are similar in type though the Huancayo range is much greater than that at Alibag. The type of the Alibag curve suggests that the S_q curves for Kodaikanal will possibly be similar to that at Huancayo, both in intensity and type. The analysis of Schmidt show that the different harmonics in the solar diurnal variation of H at Bombay and Singapore ($\phi = 1 \cdot 3$, $\lambda = 103 \cdot 8$, $\psi = -210 \cdot 1$) are similar both in amplitude and phase, though the values of ϕ at those stations differ widely. On the other hand the S_q curves for Potsdam and Irkutsk are similar, though the values of ψ for these stations differ. The above anomalies indicate a geomagnetic control of S_q variations for low latitude stations although for high latitude stations it is more dependent on geographical co-ordinates.

According to the Dynamo theory, S_q is produced by the Ionospheric currents which, however, is governed mainly by the atmospheric conductivity K and the daily convection currents. It is quite possible that the latter depends only on the sun's zenith distance, and so the above anomalies can be explained if K is supposed to vary with ψ, particularly for low latitudes. Appleton[3] has recently shown that the maximum noon ionization density in the F_2 layer depends on the geomagnetic co-ordinates. In view of the arguments given above it is quite probable that, at least for low latitudes, K does not depend on the zenith distance of the sun as has always been assumed so far, and that the probable seat of the S_q current system is in the F_2 layer. It should be noted that S_q depends on the integrated conductivity of the conducting layer, whereas the maximum ionization density depends critically on the heating effects associated with the ionization and the consequent variation in the thickness of the layer, which is larger in the F_2 layer as compared to that in the E and F_1 layers. Consequently it is quite probable that although K increases as one approaches the magnetic equator, the maximum noon ionization density, after an initial rise diminishes to a low value at the magnetic equator. This fall is probably due to the heating and expansion in the F_2 layer and is further accentuated by the "bite out" effect in the diurnal curve of maximum ion density. The fF_2 curves[4] show that as at Huancayo the "bite out" effect exists also at Madras though it is absent at Delhi.

Alibag Observatory,
Bombay, S. K. CHAKRABARTY.
August 8, 1946.

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1. Bartels and Johnston, *Terr. Mag.*, 1939, **44**, 455. 2. Moos, *Colaba Magnetic Data*, Part II, 290. 3. Appleton, *Nature*, 1946, **157**, 691. 4. *Ionospheric Data* (published by A.I.R., Delhi), 1946, **2**, 4.

A NEW FIND OF FOSSILS IN VINDHYAN ROCKS OF ROHTAS HILLS IN BIHAR

A FEW months back while on an inspection of the limestone quarries about 15 miles south-west of Dehri-on-Sone (E.I.R.) in the company of Mr. R. S. Singh, M.Sc., the author picked up a few slabs of limestone which carried some peculiar structures. On previous occasions similar finds from the same quarry were passed off as possibly inorganic concretions or solution structures and were neglected. On this occasion, however, the structures observed had such a regularity in form though different in sizes and had such a strong resemblance to some known primitive molluscan fossils that they deserved a very careful examination.

One limestone slab carried on one side four shell-like structures of different sizes ranging from half an inch to nearly two inches in length, all conical in shape, broad at one end and gradually tapering at the other with a semicircular cross-section. The broader end shows an abrupt though inclined termination the slope of which bears a constant angle in all the specimens. This sloping terminal end is somewhat worn out in three specimens but one has a layered lid-like structure. The main body of the specimens is distinctly striated transversely.

Besides these four shell-like structures the same limestone slab also carries three depressed impressions which are incomplete but what little is preserved shows that they are impressions of similar shell-like structures and represent the plane face of the body (Fig. 1).

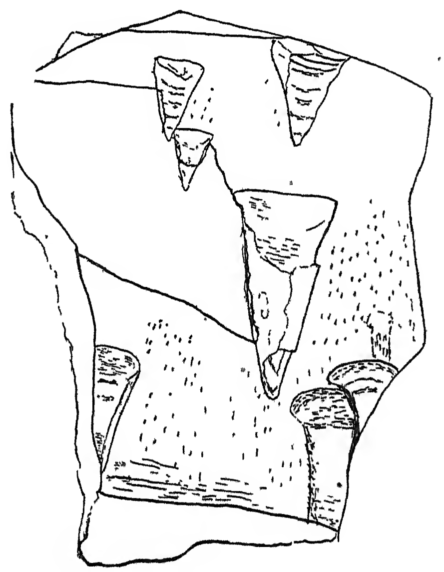

FIG. 1. Vindhyan limestone with shells and impressions of *Hyolithes rohitaswei* sp. nov. × ·5.

In addition to these large-scale structures the slab also carries a swarm of minute elongated bodies each slightly bulging in the

middle and tapering at the ends. They are lying on the slab with a distinct parallelism among themselves as well as with the larger conical bodies. One very striking characteristic of these minute bodies is that their lower end is in every case distinctly darker than the rest of the body. This shows that these minute bodies probably represent the early larval stages of the same organism as is represented by the large conical shells.

These shell-like structures have a shape already too exceptional for concretions whereas the constancy of other characters makes it difficult to conceive that the structures could be of inorganic origin unless Nature is out to produce deceptive appearances. These shells on the other hand have a strong resemblance to certain Pteropods which are typical of early Palæozoic life. The various characters noted above are all characteristic of the genus Hyolithes which has a range from Cambrian to Permian. This genus is already recorded from the Neobolus beds of the Salt Range, from the Upper Hymantas (Middle to Upper Cambrian) of Kashmir and of Spiti and also from the Ordovician of Burma.

As for the life during the Vindhyan Period it had always been a matter of surprise that the rocks of the period though very well suited to preserve the life-forms are so completely devoid of any recognisable fossil remains. However, some discoidal bodies were obtained on a number of occasions and have been lately described by Chapman as belonging to Atrematous Brachiopods and creating a new genus 'Fermoria' to receive them. Dr. M. R. Sahni, however, doubts their Brachiopod affinities though he also believes in their organic nature.

These fossils described by Chapman under the generic term Fermoria all come from Suket Shales of Neemuch and Rampura in Central India, from a horizon near the junction of Lower and Upper Vindhyans.

The present collection from the Rohtas Hills also contains a number of discoidal remains which have a strong resemblance to Brachiopods of the Orthis type whereas there are others which are distinctly inequilateral and may belong to some primitive Lamellibranch. A systematic study of these is yet to be undertaken. The present collection comes from a band of limestone near the top of the Rohtas Stage which is the youngest of the Semri Series or the Lower Vindhyan formation. Thus the two fossil horizons are at the transition of the Lower and the Upper Vindhyan systems and as such are approximately homotaxial.

This introduces a great plausibility that the conical and discoidal bodies in this collection are fossil remains belonging to the earliest molluscan types.

The conical remains described above are easily preferable to the Pteropod genus Hyolithes and as figured below has been named *Hyolithes rohitaswei* sp. nov. from its occurrence in Rohitas Hills. Its specific characters may be described as follows:—

Hyolithes rohitaswei sp. nov.—Shell symmetrical, conical, straight, cross-section plano-convex, attached to the rock along flat face which bears numerous transverse striæ at the anterior end but is nearly smooth in its posterior part; the curved face distinctly striated transversely some of the striæ being deeper and more prominent than others giving a septate form, the anterior end with an abrupt though inclined termination with a definite slope; aperture completely closed by an operculum semi-circular in outline and with layered structure. Occurrence: Top zone of Rohtas Stage of the Semri (or Lower Vindhyan) Series. Locality: Three miles west of Ramdhera on Sone R.S. (D.R.L.R.) in Shahbad district, Bihar.

The age of the Vindhyans on the basis of these fossil remains appears Lower Palæozoic and is very likely Cambrian.

Dalmianagar, K. P. RODE.
September 3, 1946.

A NEW ANTI-ALLERGIC SERUM

ALLERGIC reactions, which appear in man after injection of horse serum, are believed to be manifestations of antigen-antibody reactions. These reactions would, therefore, be prevented if either of the reagents could be inactivated.

Enzymic treatments[1,2] of horse serum proteins appear to reduce their specific antigenicity. Since the enzyme-treated immune horse serum globulins have been brought into use in man, the incidence of serum reactions is reported to have been significantly less than usual; A large part of the immune bodies is, however, lost during enzymic treatment and subsequent processing. Hence, the cost of production of the therapeutic serum is considerably increased.

The alternative method of preventing serum reactions by inactivating the antibody has given satisfactory results. In this method, antibodies to the human serum proteins are used to inactivate the antibody which is responsible for serum reactions. For this purpose, anti-human serum is prepared in horses. Horses are injected intravenously every fifth day with pooled human serum of doses which gradually decrease from 250 ml. to 25 ml. The serum of such horses contains complement fixing antibodies to human serum proteins, and inhibits appearance of serum reactions in man. Thus, the same serum, which contains the antigen which is responsible for the serum reactions, also contains the protective substance which inhibits serum reactions presumably by inactivating the antibody.

The anti-human serum has not shown any untoward effects in man. It is, therefore, quite safe to use this serum in man for the prevention or inhibition of allergic reactions. The very simplicity of the method of preparation of this serum, and the absolute safety in its proper use, make the procedure eminently suitable for application in man.

Dept. of Antitoxins and Sera,
Haffkine Institute, D. C. LAHIRI.
Bombay,
August 14, 1946.

1. Pope, C. G., *Brit. Jour. Exp. Path.*, 1938, **19**, 245.
2. Coghill, R. D., Fell, N., Creighton, M., and Brown, G., *J. Immunol.*, 1940, **39**, 207.

THE SOURCE OF CARBON AS A DETERMINANT IN DIASTASE-FORMATION BY *ASP. ORYZAE*

As a natural sequence to our studies on the influence of the nature of nitrogen in diastase-formation,[1,2] a study of the role of carbohydrates in diastase formation by *Asp. oryzæ* was taken up. The literature on this subject is meagre and though a certain amount of work has been done by Saito[3] and by Funke,[4] no details are available regarding the comparative diastase forming efficiency of the various forms of carbohydrates. The following is an attempt to determine the relative efficiencies of a group of the more commonly available carbohydrates in stimulating diastase-production by *A. oryzæ.*

Experimental

The carbohydrates used are arabinose, xylose, galactose, glucose, mannose, lactose, maltose, sucrose, raffinose, inulin and starch. The nitrogen source for the organism was potassium nitrate. The salt mixture was composed of KH_2PO_4—2·5 gms., $MgSO_4.7H_2O$—0·5 gm., $CaCl_2.2H_2O$—0·5 gm., $ZnSO_4$—0·025 gm., $FeSO_4.7H_2O$—0·0'5 gm. (dissolved in water, enough HCl added to dissolve the precipitate and volume made up to 250 c.c.).

The composition of the media was as follows: Carbohydrate equivalent to 20 mg. carbon; KNO_3 equivalent to 2 mg. nitrogen; salt solution 0·5 c.c.

Final pH adjusted to 6·5 and vol. made upto 4 c.c. in each case. The method of growing the fungus[5] and the determination of the diastatic activity of the extracts[6] are the same as described previously. The results are given below:—

TABLE I

Total Activity of the Extracts in Lintner Units

Carbohydrate	Arabinose	Xylose	Galactose	Glucose	Mannose	Lactose
Total Activity (L.U.)	23·1	31·9	28·8	127·9	19·6	15·7

Carbohydrate	Maltose	Sucrose	Raffinose	Inulin	Starch
Total Activity (L.U.)	282·4	53·2	45·9	6·9	280·0

Discussion and Conclusions

The results show that starch and its hydrolytic products, glucose and maltose, are prominent as diastase producers. The other carbohydrates are not efficient in stimulating diastase-formation, the lævorotatory inulin being the poorest. The same phenomenon of increased diastase-production by starch, maltose and glucose in the case of *Asp. niger* has been observed by Funke.[7] Only slight growths were obtained in the case of arabinose, lactose, mannose and inulin; a better growth was, however, secured with raffinose, galactose and xylose as the source of carbon. Sucrose gave rise to a fairly good growth, but in the case of maltose, glucose and starch there was abundant growth.

The increased diastase production by *Asp. oryzæ* with maltose and starch as carbon sources is in accordance with Yudkin's "mass action theory of enzyme formation,"[8] which postulates the mediation of a precursor for the elaboration of adaptative enzyme. The precursor which in the cell may be quite a negligible amount is supposed to be in equilibrium with the enzyme. The addition of the precursor, usually the substrate or its hydrolytic intermediaries will shift the equilibrium in favour of an increase in the concentration of the enzyme.

M. R. Raghavendra Rao.
M. Sreenivasaya.

Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
July 23, 1946.

1. Bindal, A. N., and Sreenivasaya, M., *J. Sci. and Ind. Res.*, 1945, **3**, 386. 2. Raghavendra Rao, M. R., and Sreenivasaya, M., *Ibid*, 1946, **4**, 654. 3. Saito, K., *C.A.*, 1911, **2**, 707. 4. Funke, *Ibid.*, 1929 **28**, 4489. 5. Raghavendra Rao, M. R., and Sreenivasaya, M., *Curr. Sci.*, 1946. 6 Bindal, A. N., and Sreenivasaya, M., *J. Sci. and Ind. Res*, 1944, **3**, 245. 7. Funke, G. L., *Zbl. Bakt.*, 1923, **59**, 162. 8. Yudkin, J., *Biol. Revs.*, 1938, **13**, 93.

REACTIONS BETWEEN IODINE AND SODIUM SALTS OF CARBOXYLIC ACIDS IN PRESENCE OF METAL IONS AS CATALYST

(*i*) *Photo-reactions*—

A study of reactions between iodine (dissolved in KI) and sodium salts of the following carboxylic acids in light (illuminated by 1000-watt lamp) indicates that contrary to the observations of Dhar and co-workers[1,2] and unlike the potassium oxalate iodine reaction, these reactions proceed with negligibly low velocity at room temperatures (about 30°-40° C.) provided the reactants used are pure and precautions are taken to account for the loss of iodine by evaporation. The acids examined are: Acetic. Propionic, Butyric, Succinic, Malic, Benzoic, Phthalic, Glycollic, Lactic, Malic, Tartaric, Citric, Mandelic and Glyceric.

Further, it is found that addition of traces of certain metallic ions like Mn (II), Cr (III), Fe (III), Co (II), UO_2 (II), and Ce (III) promotes reactions with salts of hydroxycarboxylic acids to varying degrees. Out of these Mn (II) and Cr (III) are most effective in all cases. The carboxylic acids containing no -OH group, however, do not react in light in the presence of added catalysts with the exception of Mn (II) which is oxidised to MnO_2 and hence precipitated. The factors which influence the reaction rates are many; thus increase of $[H]^+$ ultimately suppresses the reaction, whereas withdrawal of I_2 in the equil-

ibrium $I' + I_2 \rightleftharpoons I'_3$, as the amount of I′ present progressively increases in the course of reaction, renders kinetic interpretation difficult. Moreover, in some reactions solid iodination products appear, which effectively rules out photochemical measurements for the purposes of determining the order of reaction, quantum yield, etc. There are a number of other complications, the details of which together with a probable mechanism of reaction based on the formation of co-ordination compounds will shortly appear in the *Journal of Indian Chemical Society*.

(*ii*) *Dark reactions*—

As expected from the behaviour of photoreactions, no reaction takes place in the dark between salts of non-hydroxycarboxylic acids and iodine even in the presence of catalysts excepting Mn (II) which is very slowly oxidised and precipitated as MnO_2.

The reactions with salts of hydroxycarboxylic acids (mentioned above) are very slowly catalysed in the dark by some of the metallic ions specially Mn (II) and Cr (III) and also by Co (II) in some cases. No appreciable change takes place within the first ten to twelve hours, hence it was at first thought that there was no dark reaction at all and so reported in a preliminary communication.[3] Detailed investigation has shown that dark reactions do take place extremely slowly, and in some cases it takes a few weeks for completion of the reaction at the room temperature. Recently Qureshi and Veeriah[4] have reported similar observations in the case of sodium citrate-iodine reaction pointing out the existence of what may be called an "induction period". In the cases tried in this investigation long "induction periods" have been observed in dark reactions specially with those of citrate and malate in presence of Mn (II) as catalyst. The details of the dark reactions will be the subject of a separate communication to be published in due course.

Chemistry Department,
Lucknow University,
Lucknow,
August 16, 1946.

T. N. SRIVASTAVA.

1. Mukerji and Dhar, *J. Ind. Chem. Soc.*, 1925, **2**, 277; *J. Phys. Chem.*, 1928, **32**, 1308; *J. Ind. Chem. Soc.*, 1929, **33**, 850. 2 Bhattacharya and Dhar, *Ibid.*, 1929, **6**, 451. 3 Srivastava, *Proc. Ind. Science Congress*, 1944, Part III, Abstracts, p. 26. 4. Qureshi and Veeriah, *Curr. Sci.*, 1946, **15**, 132.

ALUMINIUM BORATE GEL

IN continuation of our previous work[1] on the preparation of several sols and gels, an attempt has now been made in this laboratory to prepare aluminium borate gel and this communication describes the conditions under which it can be obtained.

When a saturated solution of borax is gradually added to aluminium chloride solution, a bulky precipitate of aluminium borate occurs which dissolves on shaking, but when sufficient quantity of borax has been added, the precipitate settles down in the form of a bulky opaque jelly. By regulating the concentration of borax, transparent jellies can be obtained, and the time of setting can be extended over a period of several hours.

To 2 c.c. of a solution of aluminium chloride, containing 24·88 g. of Al_2O_3 per litre, varying amounts of 20 per cent. borax solution were added. The total volume was kept 5·5 c.c. in each case. The mixtures were shaken and the time of setting and the nature of the gel were recorded.

Amount of 20% borax (c.c.)	Time of setting (hours)	Nature of jelly
3·5	Instantaneous	Opaque
2·8	5	Opalescent
2·7	10	Transparent
2·6	18	Transparent
2·5	28	Transparent

These jellies are perfectly stable and exhibit no syneresis. On vigorous shaking they assume a liquid form and the viscous liquid so obtained again sets to a jelly on standing, and this process can be repeated several times. These jellies are, therefore, thixotropic in nature.

My grateful thanks are due to Dr. Satya Prakash for his kind interest in this investigation.

Chemical Laboratories,
Allahabad University,
June 15, 1946.

S. P. MUSHRAN.

1. Mushran, *Curr. Sci.*, 1945, **14**, 123, 200, 233; 1946, **15**, 24. Mushran and Prakash, *J. Ind. Chem. Soc.*, 1946, **23**, 111.

COMPOSITION OF "RAINTREE' FRUITS

Pithecolobeum saman or the Rain Tree is widely grown around Bangalore. The tree bears pods 4-5″ long and ½″ broad, having 6 to 8 seeds which are enveloped in a sweet edible pulp. The pods are readily eaten by cattle. The pods ripen from March to May and they are specially welcome because cattle food is not available during the dry season in plenty.

Analysis of six samples of the pods of the Rain Tree have been carried out to determine their nutritive value. The average of the results is given in the following table. Figures in column 7 were obtained by subtracting the sum of the rest of the constituents from 100.

Chemical Compositions (per cent.) of the Kernels, Seeds and Whole Pods

	Whole pods	Kernels	Seeds
1. Moisture	15·30	16·05	7·55
2. Ash	3·19	3·01	3·54
3. Fat	2·07	1·27	4·26
4. Proteins	12·71	10·55	28·57
5. Crude Fibre	11·43	10·77	14·05
6. Sugars	29·71	35·59	5·36
7. Carbohydrates (other than sugars and crude fibre)	25·59	22·86	36·67
8. Calorific value (100 gm. fresh material)	298·15	294·71	329·02

It was observed that as the season advanced from March to May, the moisture percentage decreased from 20 to 12 per cent. in the whole fruits and the percentage of other constituents increased correspondingly.

The above results closely agree with those for kernels given by Velenzuela and Wester (1930). Padilla and Soliven (1933) found 59·72 per cent. proteins and 11·16 per cent. fat in seeds. These figures are much higher than those given in the above table.

The results show that the pods of Rain Tree are a good source of proteins, carbohydrates and minerals and may equal good quality hay in nutritive value.

The authors wish to express their thanks to Mr. M. C. Rangaswamy, the Director of Dairy Research, for his keen interest and Mr. D. Narayana for supplying the samples of Rain Tree pods.

V. R. BHALERAO.
NOSHIR N. DASTUR.

Imperial Dairy Research
Institute, Bangalore,
August 31, 1946.

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THE EFFECT OF PROCESSING AND SOURING MILK BY THE INDIGENOUS METHOD

VARIOUS workers have recorded the chemical changes in milk resulting from different types of heat treatment. Anantakrishnan and co-workers[1] have reported as loss the contents of the skin formed on the surface of milk on boiling. But as the practice stands in the Indian household, the skin is invariably utilised for making curd, butter or other food preparations. It is never wasted.

When milk was maintained at the boil (96° C.) for ten minutes and continuously stirred to prevent formation of the skin on top or setting of the casein at the bottom, the loss in milk solids, after correction for the change in volume was found to be almost insignificant —0·28 per cent. total solids, 0·1 per cent. fat and 0·14 per cent. lactose. The per cent. reduction in volume, however, changed widely with the total time taken for heat treatment.

The effect of this type of processing on the bacterial count of milk was also remarkable. When the processed milk was cooled in the open vessel in which it was boiled, the reduction in plate count was from about 130,000 to 275 per c.c. The efficiency was further improved if the heated milk was transferred into a closed vessel and then cooled (360,000 to 120 per c.c.). The greater efficiency was also reflected in the storage property of the processed milk. While the milk cooled in the open vessel and then stored in a closed vessel at room temperature (18°-30° C.) developed 4,000 colonies per c.c. in 5 hours, the milk cooled and stored in a closed vessel had only 2,600 per c.c. after 7·5 hours. It is evident, therefore, that this type of heat treatment is not only more efficient but also better suited than pasteurisation[2] for tropical climate and the actual conditions prevailing in Indian homes.

On souring previously boiled milk with seed curd at 40° C., there was quick rise in bacterial count with the progress in souring. The most significant feature was the uneven distribution of the bacterial population of curd between butter and butter-milk on churning: almost all the organisms passed into butter-milk leaving only a small fraction in butter. A similar observation has also been made in the creamery process of making butter.[3,4] The low-count butter thus produced by the indigenous method compares very favourably with that produced under the best conditions by the creamery process.

The detailed procedure and results of the experiment will be published elsewhere.

I am thankful to Mr. B. N. Banerjee and Prof. V. Subrahmanyan for kind encouragement.

Dept. of Biochemistry,
Indian Institute of Science,
Bangalore, K. S. RANGAPPA.
August 10, 1946.

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ISOMERISATION OF THE DARK GREEN CHROMIUM CHLORIDE, A SEMI-MOLECULAR PROCESS

THE process of isomerisation of chromium chloride hexahydrates is shown to be highly complicated by a number of workers.[1,2,3] In the present investigation the authors find that the time taken to complete any definite fraction of the transformation of the dark-green chromium chloride into the hydrated violet form is proportional to the square root of the concentration of chromium chloride. The calculations have been made using the experimental data from the papers of Bjerrum[2] and Lamb and Fonda,[3] who followed the transformation by measuring the changes in the electrical conductivity with time of a freshly prepared solution of the dark-green chromium chloride. The values for $\sqrt{a}/tx$ show complete concordance (where a is the gm. mols. of chromium chloride per litre and tx is the time required for x per cent. change), as will be seen from the results given in the table below:

	Concentration of $CrCl_3$		
$\left(\dfrac{\sqrt{a}}{t_{0\cdot5} \text{ at } 25^\circ\text{ C}}\right)$	0·01074M	0·00322M	0·00793M
	0·0032	0·0032	0·0033

For a reaction of the nth order $t \propto \dfrac{1}{a^{n-1}}$.

Now as $t \propto a^{1/2}$ in the present case, it can be inferred that the reaction is semimolecular. Further from a comparison of the time of the

half change of chromium chloride of the same molar strength at different temperatures, it is seen that the transformation is accelerated to a great extent by a rise in temperature, the rate of the change in equimolar solutions at 25° C. being 2·2 times of that at 19·85° C. and 43 times of that at 0° C. The high temperature coefficient also shows that the order of the reaction is less than unity.

The chlorides of sodium and potassium have no effect on the rate of the transformation. On the other hand, the reaction is considerably retarded by H^+ ions. Further work is in progress to elucidate the mechanism of this semi-molecular process.

Department of Chemistry,
D. A. V. College,
Sholapur,
August 3, 1946.

D. S. DATAR.
D. R. KULKARNI.

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A METHOD OF CALCULATING "SINGLE-VALUE-FIGURE" FROM THE RESULTS OF AGGREGATE-ANALYSIS OF THE SOIL

THE most common and the one very widely used method of presenting the results of aggregate analysis of a soil is by drawing a size-distribution-curve in which the summation percentages of fractions are plotted against the logarithms of their settling velocities in water. In their studies on the effect of different irrigational, manurial and cropping treatments on the periodical changes in the structure of the soil, the authors noticed that the size-distribution-curve failed to bring out prominently the small differences in the structure of the soil brought on as an effect of season and treatment. The mathematical formula suggested by Baver and Rhoades (1932) for characterising the state of aggregation of the soil could not be used, as the aggregate-analysis of the soil was carried out on field-moist sample without dispersion. Similarly the formula suggested by Cole (1938-39) for working out the relative surface area contributed by the soil aggregates graded by sieving could not be correctly applied as the analysis of the soil was carried out by combining the sieving operation with elutriation. In recent years the use of a single-value-figure for specifying a particular property of the soil has gained much favour and it is proposed to give in this note a method of working out a "single-value-index" for studying the structural condition of the soil when the aggregate analysis is carried out by combining the two operations.

SIEVING OF THE SOIL

The sieving of the soil is carried out under the surface of water and the bank consists of sieves having apertures of the following diameters:—No. 1=7 mm., No. 2=4 mm., No. 3=2 mm., No 4=1 mm., and No. 5=½ mm.

If a, b, c, d and e are percentage fractions collected on sieves 1 to 5 respectively, then the area contributed by each of the fractions can be obtained by dividing the percentage fraction by the average diameter of the fraction and would be equal to:—

$$a/7;\ b/\frac{7+4}{2};\ c/\frac{4+2}{2};\ d/\frac{2+1}{2}\ \text{and}\ e/\frac{1+0\cdot5}{2}$$

the fraction collected on the first sieve being arbitrarily assigned a value of 7 mm. The total area contributed by all the aggregates graded by sieving would be the sum of all the figures shown above and denoted as 'S'.

ELUTRIATION OF THE SOIL

The elutriator (Kopecky's type) has four cylinders, each separating the particles into aggregates having the ranges of diameters shown below:—

No. 1 = 0·50 mm. to 0·20 mm.; No. 2 = 0·20 mm. to 0·10 mm; No. 3 = 0·10 mm. to 0·05 mm.; No. 4 = 0·05 mm. to 0·02 mm. Particles smaller than 0·02 mm. in diameter pass out of the elutriator, and their percentage is calculated by difference. If x_1, x_2, x_3 and x_4 are the percentage fractions collected in cylinders 1 to 4 the area contributed by each of the fractions would be equal to:—

$$x_1/\frac{0\cdot5+0\cdot2}{2};\ x_2/\frac{0\cdot2+0\cdot1}{2};\ x_3/\frac{0\cdot1+0\cdot05}{2}\ \text{and}\ x_4/\frac{0\cdot05+0\cdot02}{2}.$$

The fraction passing out of the elutriator would contribute an area =

$$\frac{\text{percentage fraction less than } 0\cdot02 \text{ mm.}}{0\cdot02}$$

The total area contributed by all the fractions graded by the elutriator would be the sum of all the above figures and denoted by letter 'E', and the total area contributed by all the soil aggregates graded by sieving as well as by elutriation would be the sum of the two figures S and E, calculated in the manner described above.

The elutriator separates particles of very fine size and so it will be seen that even small differences in their percentage greatly influence the value for the total surface area of the soil. On the other hand, large differences in the coarser fractions graded by sieving do not affect this value to a great extent. It would, therefore, be evident that soils which contain larger amounts of the finer fractions will show very much higher figures for the total surface area than those which contain smaller amounts of finer fractions. Assuming that high proportions of aggregates less than 0·50 mm. in diameter would affect the structure of the soil adversely, it follows that higher the figure for the total surface area worse the structure.

It is suggested that the single-value-figure calculated in the manner described above would furnish a very useful index for the structural condition of the soil when the grading of the soil is carried out by combining the sieving operation with elutriation.

Sugarcane Research Station,*
Padegaon,
June 17, 1946.

J. K. BASU.
M. M. KIBE.

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* This Scheme was partly subsidised by the Imperial Council of Agricultural Research, India.

VIABLE SUGARCANE SEED PRODUCED IN THE UNITED PROVINCES

The accepted notion so far has been that sugarcane does not set viable seed in the United Provinces. The prevailing low temperature at the time of anthesis is supposed to be responsible for this behaviour.

Due to this belief no serious attempt has so far been made to raise seedlings from fluff occurring naturally in the province. In order to critically test the validity of this belief fluff was obtained this year from Gorakhpur and also from the village Sohna, situated at a distance of forty miles north-west of Basti town. The fluff from Gorakhpur was collected from a field of Co. 313 and the variety from which fluff was obtained from village Sohna, is Co. 356.

The fluff from both these places was planted at Shahjahnpur Research Station in February 1945, at the rate of one gramme to each seedling plot (1'× 1') containing rich soil manured with compost and kept under controlled humidity and average temperature of 60° F. in a glass-house. The fluff from Gorakhpur did not sprout but the fluff from Sohna village sprouted after seven or eight days and the germination was similar to that of the fluff obtained from Coimbatore. This has been repeatedly tested and the successful germination of the local fluff for the first time in these provinces has created great interest as the potentialities of this discovery are immense. Over 1,000 of these seedlings have now been transplanted in the field and their growth behaviour is under critical study.

If it is possible to get fertile seeds from crosses made in U.P. it will open a new line of research which may produce cane varieties better suited to local conditions.

Sugarcane Research Station,
Shahjahanpur, S. B. Singh.
July 30, 1946.

A NOTE ON THE OCCURRENCE OF SMUT IN *SACCHARUM MUNJA* MUNJ GRASS

Smut is a common disease of cultivated canes caused by the genus *Ustilago*, whereas the genus *Sorosporium* has been recorded (Mundkur, 1942) on *Sorghum* and *S. munja* but the allied genus *Sphacelotheca* has not been recorded before in the country on any *Saccharum*.

In a recent tour to Biknathoree on the submontane tract of Terrai region, a form of *S. munja* was collected from the sides of a stream. A clump of this form when dug out and transplanted and grown at Pusa, produced a large number of arrows, all of which were affected by a smut. The arrows, unlike in the case of the common smut (*U. scitaminea* Syd.) attacking cultivated sugarcanes, did not form a whip. They emerged in the normal manner, but remained short and stunted and appeared blackish (Fig. 1). The florets on examination were found to be all affected, each containing a mass of blackish spores in place of their essential organs (Fig. 2). Further the arrows emerged much earlier than the other forms of the species in the collection at this Station, some of them arrowing as early as May when

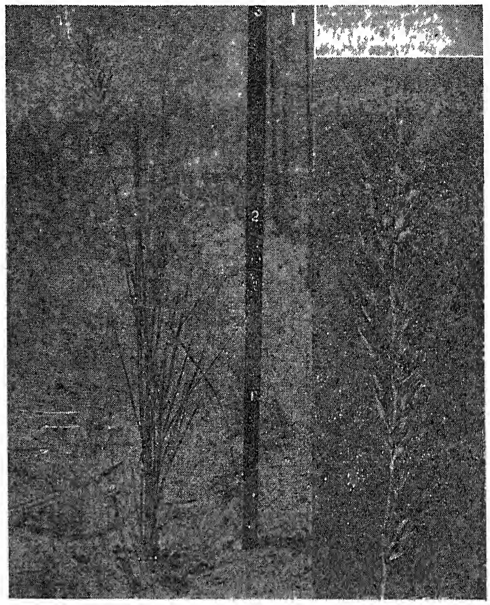

FIG. 1. A small clump about 3 ft. tall with a smutted arrow.

FIG. 2. A portion of the arrow showing smutted florets.

all other forms were not even in short blade. The arrows continued to emerge throughout the season but were all affected by smut. Only a few arrows produced about the same period as normal flowering in other forms (*i.e.*, about middle of November) were normal and healthy.

The specimens of the smutted arrows were sent to Dr. B. B. Mundkur of the Imperial Agricultural Institute, Delhi, who kindly identified the smut as *Sphacelotheca schweinfurthiana* (*Thuemen*) Saccards, a genus of smuts commonly affecting *Sorghum*, but not known so far to be attacking any species of *Saccharum*. The record is, therefore, interesting and opens further possibilities regarding sources of infection for the cultivated crops, particularly because of the very common occurrence of *S. munja* all over this tract.

Besides its occurrence, the attack of smut in this particular case, has produced a rather interesting effect, *viz.*, induced the affected clumps to arrow much earlier than the normal and healthy ones. As pointed out before, the arrows were given out even as early as May when the stalks were young and hardly 3 feet above ground. A similar tendency has already been noticed in the case of common cultivated sugarcanes, affected by *U. scitaminea* where the smutted whips have been shown to be modified floral shoots, produced as a result of early maturity (Rafay and Padmanabhan, 1940). These authors reported cases of arrowing in a smut-affected crop five months old while recent observations in Champaran by the senior author show such arrowing to be

frequent in a 42-days' old crop of Co. 513. The normal time of arrowing for this variety when planted in February is the middle of October.

So far nothing, however, is known regarding the manner this early maturation has brought about, particularly the factors responsible for the change from a vegetative to a reproductive phase, so early in life and long before the normal period of growth has taken place. It would, therefore, be quite interesting to know, whether the fungus, by its presence inside the host, brings about a change in its metabolic processes producing incidentally a phytohormone or some enzymatic secretion which in its turn induces the plant to stop its vegetative growth and proceed to the reproductive phase. If the actual reason of the actual agency behind this phenomenon could be investigated, it will undoubtedly yield a very valuable means for inducing certain late flowering varieties to arrow earlier, or even induce recalcitrant and non-arrowing varieties to arrow with the result that the duration of actual breeding operations may be extended over a large part of the crop season instead the present few months in a year. A certain amount of biochemical work now in progress in these laboratories might throw some light on the subject.

K. L. KHANNA.
K. R. RAMNATHAN.

Central Sugarcane Res. Station,
Pusa, Bihar,
August 10, 1946.

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THE UREDO-STAGE OF AECIDIUM FOUND ON *THALICTRUM* IN THE SIMLA HILLS

THE occurrence of æcidia on *Thalictrum javanicum* and *T. minus* was first reported in India by Barclay[1] in 1887. Both these species, according to Butler and Bisby,[2] probably belonged to *Æcidium urceolatum.* Arthur and Cummins[3] identified the æcidial material collected by R. R. Stewart on *T. minus* as *Puccinia Rubigo-vera* (DC) Wint. There is, however, no record based on experimental work to connect these æcidia with the uredo-stage of any rust. Mehta[4] has stated that æcidia found in nature on *T. javanicum* near Simla do not belong to the brown rust of wheat because repeated inoculations on the latter always gave negative results.

The writer, for the first time in this country, came across near Simla plants of *Agropyron semicostatum* Nees, leaves of which were infected with a brown rust (*Puccinia persistens* Plowr.), growing close to *T. javanicum* bearing the æcidium recorded before. A brief account of experimental work that established a connection between the two is given in this note.

Æcidia have been observed on leaves and petioles of *T. javanicum* in moist valleys of Simla during the rainy season, *i.e.*, June-August. Inoculations made with the æcidiospores on seedlings of wheat and barley always gave negative results as before but *Agropyron semicostatum* got infected resulting in the production of the uredo-stage of the rust. Æcidia are hypophyllous, in clusters on thickened spots which are purple-brown above and yellow below. They are subcylindrical, yellow, with torn margins. Spores are orange coloured.

In nature infected plants of *Agropyron* are found in the neighbourhood of diseased *Thalictrum.* Inoculations made with uredospores on seedlings of wheat, barley and *Agropyron* infected only the last. A culture of the rust in the uredo-stage has been maintained on its congenial host throughout the year in a greenhouse at Simla. The incubation period is seven to ten days according to weather. Uredosori are minute and orange coloured. Uredospores are more or less globose and measure 22-24 μ in diameter.

Teleuto-stage is formed when the aerial parts of the grass start drying. Teleutospores have been found to germinate at room temperature (60°-70° F.) without any special treatment and the sporidia to infect young leaves of *T. javanicum.* Spermogonia appeared in seven to ten days and æcidia in seventeen to twenty days from the date of inoculation. An infected leaf is shown in Fig. 1.

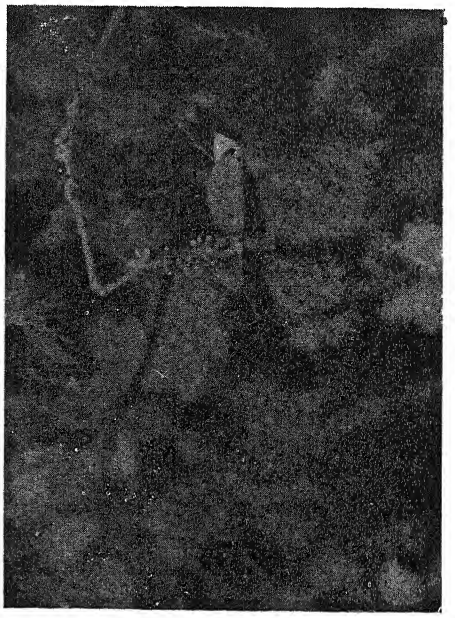

FIG. 1 Showing an infected leaf of *Thalictrum javanicum* × 4.

As expected, æcidiospores artificially produced in the greenhouse infected seedlings of *Agropyron* resulting in the formation of uredosori.

This completes the life-history of the rust, the æcidial stage of which had been recorded on *T. javanicum* by previous workers, referred to above.

Mehta[4] has recorded the occurrence of yellow rust on *A. semicostatum* near Simla and the writer has found this grass infected with

black rust. A complete account of the life-history of the latter, resulting in the identification of a new specialised form of *Puccinia graminis* is being published elsewhere. With the identification of brown rust also, as described here, all the three rusts have been recognised on this grass in this country. It should, however, be noted that they are highly specialised on *Agropyron* and do not infect either wheat or barley.

Rust Research Laboratory,
Simla-E.,   R. PRASADA.
August 10, 1946.

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CHROMOSOME NUMBER OF *CASSIA FISTULA*

ACCORDING to the international rules of botanical nomenclature, 1935, it has been proposed that *Cassia fistula* Linn. should be selected as the type species of the genus cassia. This species belongs to the sub-genus *Cathartocarpus* Pers. Tischler (1921-22) has recorded the chromosome number of this species as $n = 12$ As this number happens to be unusual outside the sub-section *Chamæcristæ veræ* Benth., the writer has undertaken to work out the detailed cytology of *Cassia fistula*. As a preliminary to this study a number of temporary aceto-carmine smears of pollen-mother-cells were examined. From the polar views of 1st metaphase 14 bivalents could clearly be counted (Fig. 1) and this number is in variance with

FIG. 1. *Cassia fistula* L. Polar view of first metaphase showing 14 bivalents × 2400.

that previously reported by Tischler. This number $n = 14$ is, however, in conformity with the previously reported chromosome numbers for those species belonging to the genus cassia; which do not fall under the section *Chamæcrista*. Detailed cytological observations are in progress and will be published elsewhere.

Department of Botany,
Andhra Christian College,   J. V. PANTULU.
Guntur,
April 21, 1926.

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A MODIFIED EMMERT'S FIELD METHOD FOR THE ESTIMATION OF NITRATE-NITROGEN IN PLANTS

EMMERT in his field method for the determination of nitrate-nitrogen in plants lays stress on the tissue being immediately weighed and titurated after detachment to minimise the loss of nitrates. But this method involves cumbersome apparatus and equipment which have to be carried to the field where the resulting colours are compared to rough permanent colour standards for visual estimation. It is with a view towards evolving a more accurate laboratory method which does away with inconvenient and inaccurate field work that the following modifications are suggested.

The main difference lies in the collection of the plant tissue samples in liquid paraffin which prevents the loss of nitrates and at the same time permits very accurate estimation in the laboratory by means of a sensitive colorimeter. By this method the reduction of nitrates to proteins by enzymes which act rapidly in the presence of oxygen is prevented for, liquid paraffin forms an impervious protective film on the cut surface as well as on the stomatal openings. For estimation of nitrates, Emmert's method was followed and the colorimetric comparisons were done according to Reilly and Rae[3] and instructions given by Dastur.[1]

Several experiments were done on different plants to show that by the modified method loss of nitrates is prevented and better results are obtained by the use of colorimeter. These are given in the following tables:—

TABLE I
Portulaca oleracea L.

No.	Time of exposure to air	By Emmert's method of Visual Estimation NO_3 in ppm.	Colorimetric Comparison by modified method NO_3 in ppm.
1	nil	400	346
2	10 minutes	400	312
3	20 minutes	400	191
4	30 minutes	400	166

TABLE II
Amarantus spinosus L.

No.	Time of immersion in liq. paraffin in hours	Estimation of NO_3 by modified method in ppm.
1	nil.	186
2	48	186
3	74	186

From the above data it will be observed that:

(1) Nitrates are lost rapidly within a very short time which goes on increasing thereafter and there is a great difference between estimations by Emmert's visual method and the present colorimetric method (Table I). It can also be seen that with mere visual comparison the loss of nitrates on exposure to air is not apparent even when the difference by the present method is sufficiently large.

(2) There is no loss of nitrates even after keeping the tissue in liquid paraffin for 74 hours (Table II).

I must here thank Prof. F. R. Bharucha for suggesting the method and for his valuable guidance.

Botany Department,
Royal Institute of Science,
Bombay,
September 2, 1946.
P. J. DUBASH.

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XENIA IN COTYLEDON COLOUR OF GRAM (*CICER ARIETINUM*)

A COMPREHENSIVE investigation on the inheritance of seed-coat and cotyledon colours in gram has recently been undertaken at the Institute of Plant Industry, Indore. Among the gram collections maintained here it is found that there are great variations in the presence and absence of anthocyanin pigment in different parts of the plant, in the size of the pod and seed, in the nature of the seed surface and in the colour of the sead-coat. The usual seed-coat colours met with are yellow, different shades of brown, light red, etc. Among the new acquisitions there are two interesting types, one obtained from a Central India State which has a black seed-coat and another obtained from C.P., which has a green seed-coat. The colour of the cotyledon which can be seen by scraping the seed-coat off is usually yellow in all varieties irrespective of the colour of the seed-coat. The only exception to the above finding is that in the variety with green seed-coat the cotyledon inside is also green.

Among the various crosses that have been made and are under study, the following two are of interest in showing xenia effect with regard to cotyledon colour. The crosses were actually made in 1944-45 *Rabi* season. Under Indore conditions it has been found that the latter half of January is the best period for the setting of pods.

	Cross I		Cross II	
	Seed Coat	Cotyledon	Seed Coat	Cotyledon
Parents	Green ♀ × Black ♂	Green ♀ × Yellow ♂	Green ♀ × Yellowish brown ♂	Green ♀ × Yellow ♂
Hybrid seed	Green	Yellow	Green	Yellow

It would be seen that while the seed-coat colour of the hybrid seeds in both crosses is the same as that of the maternal parent, the cotyledon which is the result of double fertilization has the colour of the paternal parent, showing dominance of yellow over green.

The hybrid seeds were sown in 1945-46 *Rabi* season and the produce of the F_1 plants was collected in March 1946 and examined in the laboratory for seed-coat and cotyledon colours, the latter being distinguished by scraping the coat off at a small spot in each of the seeds. There were obtained one plant with 108 seeds from the first cross and two plants with 279 seeds in the second cross. The results of this examination are given below.

	Cross I			Cross II		
Seed Coat colour	Light smoky black			Yellowish brown		
Cotyledon colour	yellow	Green	Total	yellow	Green	Total
	87	21	108	212	67	279
Exp. 3:1	81	27	108	209	70	279
X^2			1·8			0·15

The above results clearly show the incomplete dominance of black over green and complete dominance of yellowish brown over green with regard to seed-coat colour and the complete dominance of yellow over green with regard to cotyledon colour. That seeds with two kinds of cotyledon colour occur in the same F_1 plant confirms the xenia effect observed in the hybrid seed.

While the above results will be confirmed by raising an F_2 generation, the full results of all crosses showing the interrelationship among the seed-coat colours and their relationship if any, with other characters like seed size, nature of seed surface, presence and absence of anthocyanin in vegetative and floral parts, etc., will be discussed in a paper to be published elsewhere.

The work was carried out under the guidance of Mr. K. Ramiah, M.B.E., Geneticist and Botanist, Indore.

Institute of Plant Industry,
Indore,
June 3, 1946.
B. A. PHADNIS.

HEMILEIA WRIGHTIAE RAC. ON *WRIGHTIA TINCTORIA* R. & BR. AND *W. TOMENTOSA* ROEM. & SCH.

IN the months of December 1945 and January 1946, a *Hemileia* was observed on two species of *Wrightia*—*W. tinctoria* and *W. tomentosa*. The rust on the former species was prevalent in the jungles near Walayar (Malabar District) and Samalpatti (near Salem). On the latter host the rust was observed at Kallar (Coimbatore District).

Hemiliopsis wrightiæ has been recorded on *Wrightia tinctoria* in Java and was described later as *Hemileia wrightiæ* Rac. (Sydow, 1914; Stevens, 1932). But the prevalence of this rust on these hosts in South India has not been recorded. Thirumalachar to whom our thanks are due, has stated in a private communication (in May 1946) that he has collected *H. wrightiæ* on *W. tinctoria* from Mysore State.

Uredia and telia were observed on *W. tinctoria*. The *æciospores* mentioned by Stevens (1932) were not found. The colour of the sori, which exhibit a mealy appearance on the lower surface of the affected leaves, is at first

orange to cadmium orange, when the urediospores are formed. But with the formation of teliospores there is a change in colour to shell pink.

On *Wrightia tomentosa* the rust has been recorded for the first time. The lower surface of the leaf is thickly covered by extensive powdery light capuchin orange to salmon orange patches of uredia The urediospores are formed as in other *Hemileia*. One or more hyphæ which may become swollen collect in the substomatal space. These emerge through the stoma and develop a short columnar fascicle outside the epidermis. On the ends of the hyphæ forming the fascicle the spores are borne. Haustoria are clearly seen.

The urediospores are shaped like the segments of an orange, verrucose except on the flattened or concave side and have orange-coloured contents. They measure 23 × 18 μ (the range being 15·5 to 28·0 × 12 to 22·0 μ) (Fig. 1). Germination occurs by the formation of a germ tube which is irregularly swollen at the tip with reddish contents.

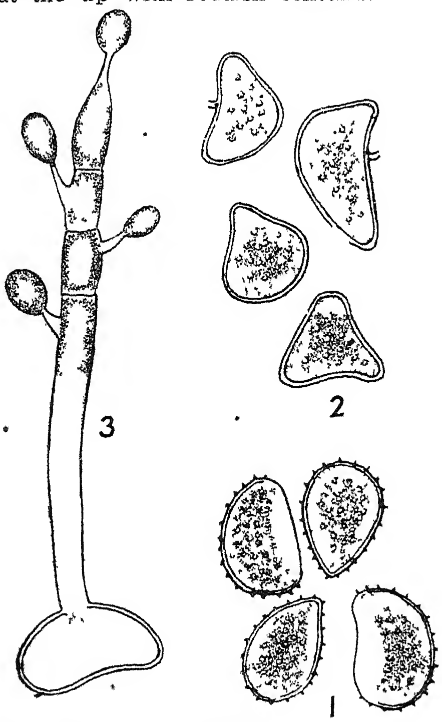

FIG. 1. Uredospores × 400.
FIG. 2. Teliospores × 400.
FIG. 3. Germination of teliospores × 400.

With the development of teliospores the colour of the rust becomes lighter and assumes a white to sea-shell pink tinge. The teliospores are formed on fascicled stalks emerging through the stomatal pore as in the uredia. They are hyaline or light brown, smooth, thin-walled, and of varying shapes. Subglobose and angular spores are present (Fig. 2). Sometimes a remnant of the stalk can be seen projecting from a side of the spore. The apical protuberance was not clear. These measure 25×19·0μ (the range being 19·0 to 31 × 15·5 to 26·0). Germination takes place in fresh spores without passing through a rest period. A stout four-celled promycelium is formed and from each cell a basidiospore develops on a short stalk (Fig. 3). Basidiospores are oval or round, hyaline and often germinate *in situ*.

The rust occurring on *W. tomentosa* resembles the one found on *W. tinctoria*. The measurements of the spores of the rust on the two hosts also agree. Therefore the rust on *W. tomentosa* is identified as *Hemileia wrightiæ* Rac.

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Coimbatore,
May 20, 1946.

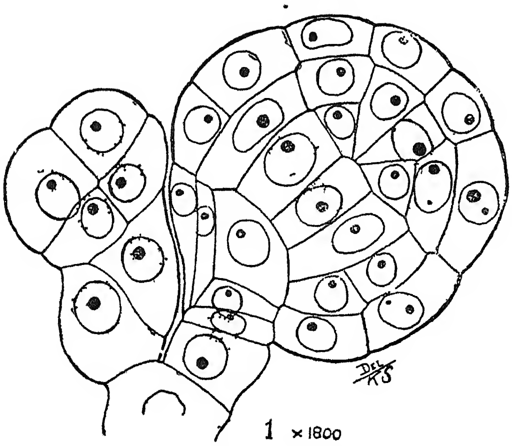
1. Saccardo, P. A., *Sylloge fungorum*, 1902, **16**, 270. 2. Stevens, F. L., *The Philippine Agriculturist*, 1932, **20**, 629. 3. Sydow. P. et H., *Monog. Ured.*, 1914, **3**, 218.

A CASE OF POLYEMBRYONY IN *ISOTOMA LONGIFLORA* PRESL.

POLYEMBRYONY, so far, has been recorded in only one member of the Lobeliaceæ, and that is *Lobelia syphilitica* Linn. by Crete (1938). In this form, he reports that one, and sometimes two embryos, frequently develop at the expense of the suspensor. The first three or four terminal tiers of cells of the proembryo take part in the formation of the primary body regions of the embryo as has been indicated for other members of Lobeliaceæ and Campanulaceæ. In addition to this normally developing embryo, some of the suspensor cells immediately below the terminal embryo undergo similar divisions and thus form a second embryo. Even in this embryo the body regions can be assigned to certain definite tiers as in the normally developing embryo. Crete further records in the same form that in addition to this new embryo, sometimes another embryo may be formed in a similar form at the cost of the suspensor.

In the present form, *viz.*, *Isotoma longiflora* Presl., another member of the Lobeliaceæ, we have met with a case of polyembryony which is similar to the one described by Crete for *L. syphilitica* The mode of embryogeny of this form (to be published elsewhere) closely follows that seen in other members of the Lobeliaceæ and the Campanulaceæ. The terminal three or four cells of the proembryo take part in the development of the embryo. In addition to this embryo, a case was met with in the present form, wherein another embryo appears to have been budded out laterally from a suspensor cell situated below the normally developing embryo (Fig. 1). Even in this lateral embryo three tiers of cells can be made out, each tier consisting of four cells. In all the three tiers the first wall has been

laid in a vertical manner (though slightly oblique in the third tier) and this is soon followed by a second set of vertical walls at right angles to the first, thus resulting in three tiers of cells, with four cells in each tier. The newly budded out embryo is at a comparatively lower stage of development when compared with the normal embryo.



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In *L. syphilitica* Crete reports one or two embryos developing at the cost of the suspensor. In *Isotoma longiflora*, however, the additional embryo appears to have taken origin as a budding from one of the terminally situated suspensor cells.

Our sincere thanks are due to Dr. L. N. Rao for kind encouragement.

Department of Botany, Central College, July 30, 1946.

S. B. KAUSIK
K. SUBRAMANYAM

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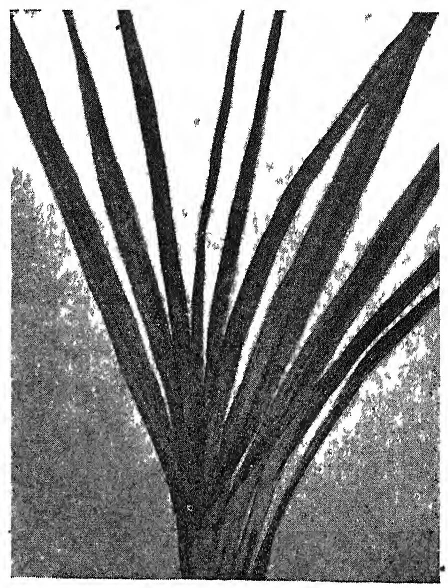
MOSAIC DISEASE OF RAGI (*ELEUSINE CORACANA* GAERTN.)

THE mosaic disease of ragi has been referred to only by Mc Rae[4] as occurring in the Vizagapatam District of the Madras Presidency as far back as 1928. Since that time no mention has been made of it as far as I can gather, anywhere in India. It will, therefore, be of interest to note that it occurred on a fairly extensive scale in the Mysore State (in the districts of Chitaldrug, Tumkur, Kolar and Mandya) during June and July 1946. Due to the failure of the monsoons in 1945, and due to the threat of famine attempts were made to cultivate an early *kar* irrigated crop of ragi in different parts of the State. The commonest variety found to be attacked was a *gidda* ragi, seeds of which were distributed from Challakere in the Chitaldrug District. A local variety in Malur also got infected by the disease.

The first symptom of the disease is the appearance of pale patches on the green leaves (see figure). These are very distinct as the leaves unroll from the spindle, and hence the newly-opened leaves have to be examined for the characteristic symptoms. The pale areas vary in size and shape, are irregularly oval, and distributed with their linear axes running parallel to the midrib. They are not limited by the veins and are of varying width. Some of the plants in the field may be stunted and show a general yellowing of the leaves. This may be due to abnormal soil conditions or an excessively wet growing period as noticed by Coleman.[2] Mosaic infected plants may recover at a later period of growth and put forth normal earheads. The disease has been noticed to infect from 10 to 30 per cent. of the plants in severe cases.



There is no reason to suspect that the disease is seed-borne, as none of similar diseases has been known to be transmitted in this manner (Brandes and Klaphaak[1]). The disease is similar to sugarcane mosaic which has been known to be transmitted by *Aphis maidis*. It is interesting to note that mosaic infected ragi plants were found to be badly infested with *Aphis maidis*.* Jola plants (*Sorghum vulgare* Pers.) in the vicinity showed some symptoms of mosaic, although sugarcane itself was found to be free. It is possible that the sugarcane at that time was not in a stage to show up the symptoms. Kunkel[3] says that goose grass or *Eleusine indica*, and a number of other grasses are subject to mosaic disease in Hawaii and that cross-inoculation tests have not been made although the disease on these plants is probably identical with that on sugarcane. Brandes and Klaphaak,[1] however, obtained negative results in insect transmission experiments with the virus of sugarcane mosaic on *Eleusine coracana* with *Aphis maidis* as vector. They do not take this as conclusive evidence, as admitted by various factors diminished the chances for infection in their experiments at Washington. Smith[5] lists *Eleusine*

coracana and E indica among 22 grasses found to be infected with chlorotic leaf markings resembling those of maize streak disease although he is not definite that they are all due to the same virus The symptoms of the disease on ragi suggest that it is mosaic rather than a streak disease

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in Mysore, Bangalore, S V VENKATARAYAN
July 25, 1946

* I am indebted to Mr. M Puttarudriah, Senior Assistant Entomologist, for kindly identifying the aphids

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PERFECT STAGE OF *SCLEROTIUM ROLFSII* SACC CAUSING PSEUDOSTEM-ROT OF PLANTAIN (*MUSA SAPIENTUM*)

PLANTAIN, *Musa sapientum* Linn (the variety locally known as *Rasabale*) is subject to a rot caused by *Sclerotium rolfsii*, known as *"taragumari roga"* in Mysore, Bangalore and Tumkur Districts The fungus was brought into pure culture from the diseased specimens obtained from a garden near Mysore in August 1935 In an attempt to obtain the perfect stage of the fungus in the laboratory the special medium recommended by Mundkur[4] containing onion extract, asparagin and proteose peptone was used Venkatarayan[5] reported basidiospores in culture on onion-asparagin agar in 40 days Both test-tube and petri-dish cultures grown at the ordinary laboratory temperature (17° 9-29° 1 C) and stored for 40 to 60 days, developed a thick hymenium in July 1936 The basidiospores were not noticed on potato-dextrose and oat agars The hymenium was readily made out by its white colour and dense structure (Fig 1) The basidia are clavate, hyaline, aerial, short and densely aggregated into crusts They measure 6 μ to 12 μ by 4 μ to 6 μ, average of 14 measurements being 9 μ by 4 5 μ. They bear 2-4 sterigmata The sterigmata are 4 μ long The basidiospores (Fig 2) are smooth, hyaline, ovate and measure 3 to 4 μ by 2 to 3 μ

The basidial stage of *Sclerotium rolfsii* has been observed in culture by Goto[2] on strains isolated from various hosts in Japan and by Curzi[1] in Italy on the aster and potato strains Goto referred the fungus to *Corticium centrifugum* and Curzi named his strain *Corticium rolfsii*. Hirai[3] recorded a sclerotial disease on banana fruits in transport from Formosa due to *Corticium centrifugum* The basidia of Curzi's strain measure 10 to 15 μ by 4 to 5 μ with 2 to 4 sterigmata 4 to 5 μ long with basidiospores 5 to 7 μ by 2 5 to 3 75 μ In India

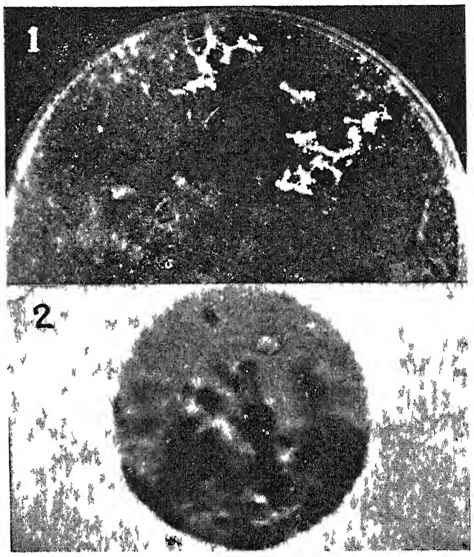

FIG. 1. Petridish culture showing the development of hymenium on onion asparagin agar.

FIG. 2 Microphotograph showing the basidiospores

Mundkur[4] succeeded in getting the perfect stage in cultures isolated from cotton, betel-vine, potato and sugarcane He called the fungus provisionally *Corticium rolfsii* Curzi The measurements of the basidia, sterigmata and basidiospores, of the plantain strain roughly correspond to those of Curzi, hence the plantain strain is probably *Corticium rolfsii* The dense nature of the hymenial crust also suggests its being *C rolfsii* rather than *C centrifugum*, which has a loose and aerial crust

The writer is greatly indebted to Mr. M J. Narasimhan, Director of Agriculture (Retd), and Mr S V Venkatarayan, Mycologist, for their kind guidance

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July 31, 1946

1. Curzi, M., *Rev. app Mycol.*, 1932, **11**, 405, 746, 748 2 Goto, K, *Ibid*, 1931, **10**, 344 3. Hirai T. *Ibid*, 1939, **18**, 40 4 Mundkur, B B, *Ind Jour. Agri. Sci*, 1934, **4**, 779 5 Venkatarayan S V. *Admn. Rept. Agri. Dept Mysore*, 1935-1936, 53

TYPE CULTURES FOR THE MICROBIOLOGICAL ASSAY OF AMINO-ACIDS

In persuance of a comprehensive programme[1,2] for determining the suitability of the Type Culture collections for the microbiological assay of vitamins, amino-acids and other active principles, we have found the amino-acid requirements of two of the lactic cultures L.C. 3, N.C.T.C. 2078, and *L. acidophilus*, N.C.T.C. 2087 taken from our repository. Several standard microbiological procedures for the assay of various amino-acids are now available.[3,4,5,6]

The experimental procedure and technique for the preparation of amino-acid mixtures, inocula and the handling of the cultures, are similar to those described by Stokes *et al.*[5] The results are given in Table I. For the purpose of comparison the amino-acid requirements *L. casei* are also given.

TABLE I

Amino-acid requirements of lactic cultures L.C. 3 and L. acidophilus

	Leucine	Isoleucine	Valine	Cystine	Methionine	Tryptophane	Tyrosine	Phenylalanine
L. casei N.C.T.C.	+	—	+	+	—	+	+	+
L. C 3 N.C.T.C. 2078	+	—	+	+	—	+	+	+
L. acidophilus NCTC 2087	+	—	+	+	—	+	+	+

	Aspartic acid	Lysine	Serine	Glutamic acid	Histidine	Arginine	Pro line	Hydroxy proline	Alanine
L. casei	+	—	+	+	—	+	—	—	—
L.C. 3 N.C.T.C. 2078	+	+	+	+	+	+	—	—	+
L. acidophilus NCTC 2087	+	+	+	+	+	+	—	—	+

	Threonine	Norleucine	Glycine
L. casei	—	—	—
L. C 3 N.C.T.C. 2078	+	—	—
L. acidophilus NCTC 2087	+	—	—

It will be seen from the table that the two cultures under study require threonine, histidine and lysine in addition to the amino-acids required by *L. casei*; thus covering a wider range of amino-acids. Further work along this line is in progress.

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Bangalore,
September 9, 1946.

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EPHELIS ON TWO NEW HOSTS*

Two species on grasses, *Isachne elegans* Dalz. (Fig. 1) and *Eragrostis tenuifolia* Hochst. (Fig. 2), were found infected by *Ephelis*, the former at the Paddy Breeding Station, Nagenhally, Mysore, and the latter at the Government Experimental Farm, Hebbal, Bangalore, in 1943-44. The infection was noticed in the vicinity of paddy fields where the crop was also attacked by the same fungus. The infected grasses were stunted in growth. The

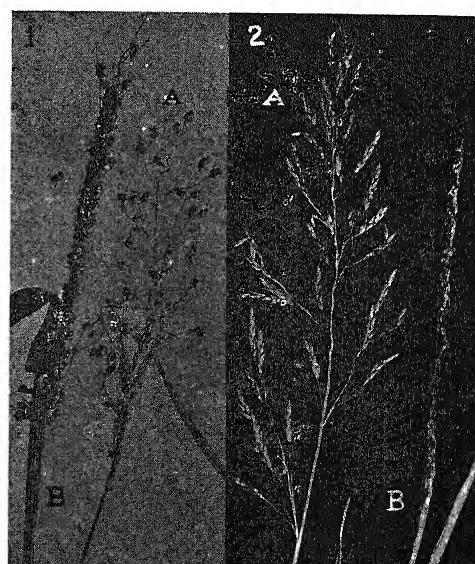

FIG. 1. *Isachne elegans.*

FIG. 2. *Eragrostis tenuifolia*, with healthy (A) and infected (B) inflorescences.

blades showed a lustrous, silvery, greyish appearance. While the inflorescence of *Isachne* and *Eragrostis* is normally a loose panicle 3″-6″ long, the diseased inflorescences were

reduced to black spikes 1″-2½″. The fungus infects the undeveloped inflorescence, surrounds the florets and the spikelets holding them all together with the main rachis. The mycelial growth forms a sort of sclerotioid mass. It is at first white to dirty grey and later turns black. The mycelium is branched and hyaline. The conidia are produced profusely and detach themselves from the conidiophores and form a gelatinous matrix. The conidia are needle-shaped, hyaline, vacuolate and measure 16 to 28 μ by 1·3 to 2 μ.

Ephelis has been noted on many plants. In India *Ephelis oryzæ* Syd. is a common parasite on paddy in Madras, Mysore, Nagpur and Poona. Butler[1] observed *Ephelis japonica* P. Henn. on inflorescence of *paspalum kora* in Sylhet and apparently the same species on *Eragrostis* sp. in the same locality and on *Panicum sanguinale*, in Dacca. Burkill noticed an ill-developed specimen on *Cymbopogon martini* var. *sofia* in Dharmpur, Punjab. Sydow and Butler[3] recorded *E. pallida* on *Andropogon aciculatus* in Tonkin and Philippines and noted the perfect stage of the fungus on the same specimen from India and called it *Balansia Andropogonis* Syd. Narasimhan and Tirumalachar[2] noted the perfect stage of *E. oryzæ* and proposed a new combination *Balansia oryzæ* for the fungus. The fungus observed on *Isachne elegans* and *Eragrostis tenuifolia* corresponds to that found at the same time on paddy where the spores measure 17 to 28 μ by 1·7 μ. The fungus is tentatively termed *Ephelis oryzæ* pending further observation of its perfect stage.

The writer is thankful to Dr. S. K. Mukerjee, Curator, Royal Botanic Gardens, Sibpur, and to Mr. S. N. Chandra Sekhara Iyer, Lecturer in Botany, Agricultural College, Coimbatore, for kind identification of specimens and to Mr. S. V. Venkatarayan, Mycologist, Bangalore, for kind guidance.

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Bangalore,
July 31, 1946.

* Paper read before the Agricultural Section of the Indian Science Congress Association, held at Bangalore in January 1946.

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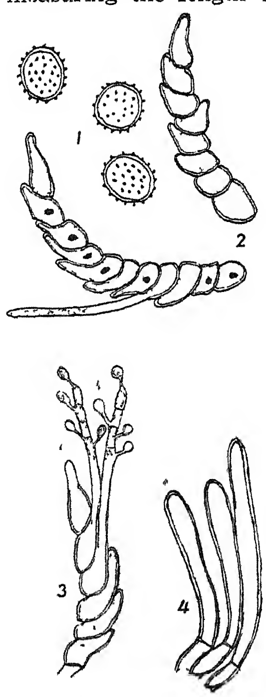
ON *CATENULOPSORA ZIZYPHI* ON *ZIZYPHUS OENOPLEA* MILL.

IN January 1946, a rust was observed on *Zizyphus œnoplea* Mill. in and around the Fruit Research Station, Kallar, in Coimbatore District. The rust formed a tawny growth on the under-surface of the leaf and was composed of numerous uredia and telia.

The uredia are erumpent. Numerous well-developed, incurved, clavate paraphyses develop round the periphery of the sorus and form a protective covering enveloping the spores in the initial stages. The paraphyses are usually two-celled with a short basal cell and a long terminal cell. They are hyaline or light brown in colour with thickened walls (Fig. 4). The urediospores are stalked, subglobose to oval, reddish-brown, echinulate and measure 22·0 × 19·0 μ (range being 17·5-28 × 14-24·5 μ). The urediospore germinates readily.

The telia are also hypophyllous, erumpent and sparsely arranged or gregarious. In each sorus an outer ring of 2-3 series of paraphyses is present surrounding the teliospores as in the uredia. The teliospores are one-celled and produced in chains. Each chain is made up of about 8 to 15 teliospores and is 150 to over 300 μ in length. The chains are free and not laterally united. But the spores forming a chain do not easily separate. A beak-like projection is present on one side of the teliospore and it projects closely pressed to one side of the spore above. All the beaks of the teliospores of a chain are usually on the same side. The topmost teliospore has a centrally placed beak (Fig. 2). The teliospores measure 30·0 × 12·7 μ (27·9-46·5 × 9·3-18·6 μ). In measuring the length of the telio-



FIGS. 1 Urediospors. 2. Teliospores. 3. Germination of teliospes. 4. Parapybses. All × 200.

spore the beak is also included. The teliospore wall is smooth and the spores are coloured light brown. Germination of the teliospore takes place in 8-12 hours. No resting period is necessary. The upper spores of

the chain germinate more readily than the lower ones. The beak elongates, and develops into a hyaline basidium. The upper end of the basidium is four-celled and from each cell a sterigma is developed. An oval or round hyaline basidiospore is formed on each sterigma (Fig. 3).

Pycnial and æcial stages were not present. The morphological features of this fungus suggest that it belongs to the genus *Catenulopsora* erected by Mundkur and Thirumalachar (1943). This genus has been recorded by them on *Flacourtia sepiara* Roxb. and *Ampelocissus latifolia* (Roxb.) Planch.

Two rusts have been recorded on *Zizyphus* from India (Butler & Bisby, 1931). These are *Crossopsora zizyphi* (Syd. & Butl.) Syd., and *Phakopsora zizyphi-vulgaris* (P. Henn.) Diet. The fungus now described does not come under either of these genera. In *Crossopsora* a columnar telium is present. The telia in *Phakopsora* from a black lens-shaped crust and dark-brown spots are developed on the upper surface of the leaf. The rust under consideration does not form dark-brown spots on the upper surface of the leaf. A columnar telium is absent nor is it black in colour. The occurrence of the teliospores in free chains and the absence of germ pores bring this fungus into the genus *Catenulopsora*. This kind of rust has not been recorded on this host. Hence it is proposed to name this fungus, *Catenulopsora zizyphi*.

Catenulopsora zizyphi sp. nov. Uredia hypophyllous, erumpent, surrounded by a ring of clavate incurved paraphyses; urediospores subglobose or oval, reddish-brown, echinulate $22\cdot0 \times 19\cdot0\,\mu$. Telia hypophyllous, erumpent, surrounded by a ring of paraphyses; teliospores catenulate, not laterally united, provided with a beak on one side and adpressed to the spore above, one-celled, smooth-walled, light brown in colour $30\cdot0 \times 12\cdot7\,\mu$, germinating without a rest period, basidium given off from the tip of the beak; basidiospores 4, hyaline, oval or round.

Habitat, in living leaves of *Zizyphus œnoplea* in the neighbourhood of the Fruit Research Station, Kallar, Coimbatore District, Madras. Collected by T. S. Ramakrishnan and C. L. Subramaniam in January, 1946. Type specimens deposited in the Herbarium of the Government Mycologist, Lawley Road P.O., Coimbatore.

Catenulopsora zizyphi Ramakrishnan and Subramaniam, spec. nov.

Uredia hypophylla, erumpentia, circumdata anulo paraphysum, clavatorum, incurvorum. Urediosporæ subglobosæ vel ovales, rubricosæ-brunnueæ, echinulatæ $22\cdot4 \times 18\cdot9\,\mu$ (potest esse $17\cdot5$-$28 \times 14\cdot0$-$24\cdot5\,\mu$). Telia hypophylla, erumpentia, circumdata externo anulo paraphysum, duo vel tres serium. Sporidia catenulata non lateraliter unita, rostrata, unolateri et adpressa sporidio superno, unicellata, leviba, pallida brunnuea colore, $30\cdot0 \times 12\cdot7\,\mu$ (potest esse $27\cdot9$-$46\cdot5 \times 9\cdot3$-$18\cdot6\,\mu$). Germinat sine quiete, Basidium proferens e vertice rostri. Basidiosporæ quattuor, hyalinæ, ovales vel rotundæ.

Habitat. In foliis vivis *Zizyphi œnoplœ* in vicinitata "Fruit Research Station", Kallar, Coimbatore District, Madras. Collecta per Ramakrishnan et Subramaniam in mense Januario 1946. Typi specimina deposita in "Government Mycologist's Herbario", Coimbatore.

Our thanks are due to Rev. Father M. Singarayar of St. Joseph's Seminary, Coimbatore, for the Latin translation.

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Coimbatore,
April 25, 1946.

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RESEARCH SCHEMES SANCTIONED

THE Governing Body of the Council of Scientific and Industrial Research, at its recent meeting, sanctioned several new schemes of research on the recommendation of the Advisory Board costing about Rs. 2,60,000. The schemes include atomic research at the Tata Institute of Fundamental Research, Bombay, and the Bose Research Institute, research on Nuclear Physics by Prof. M. N. Saha and preparation of tannic acid from myrobalans.

The Governing Body approved the final plans for the establishment of the Fuel Research Institute and the National Metallurgical Laboratory in India. The Fuel Research Institute is to be located near Dhanbad at an estimated capital cost of Rs. 14 lakhs and the National Metallurgical Laboratory will be located at Jamshedpur with an initial capital expenditure of Rs. 42·8 lakhs. Architects for these laboratories have already been appointed by the Council and detailed estimates, plans and designs will be submitted by them for the approval of the Council.

The Governing Body noted with satisfaction that the Government of Bombay had agreed to the location of the National Chemical Laboratory on the Pashan Road at Poona and that the required land would be transferred to the Council for this purpose.

REVIEWS

Physical Methods of Organic Chemistry, Vol. II. Edited by A. Weissberger. (Interscience Publishers Inc., New York), 1946. Pp. 737-1367. Price $8.50.

The volume under review is the second one of the same title* and deals with the following ten topics: Spectroscopy and Spectrophotometry; Colorimetry, Photometric Analysis, Fluorimetry; Polarimetry; Determination of Dipole Moments; Conductometry; Potentiometry; Polarography; Determination of Magnetic Susceptibility; Determination of Radioactivity; Mass Spectrometry. It is inevitable in a composite volume by different authors that all the monographs do not show a degree of uniformity of treatment that one expects in a book by one author even though such co-ordination is the task of an editor. The preface to the volumes prepares one to expect such uneven treatment of the topics.

A perusal of the monograph on spectroscopy leaves one with a feeling of incompleteness and references to other sources a necessity. An organic chemist often has to use infra-red absorption for quantitative measurements which requires an accurate measurement of cell thickness and this appears to have no place in the monograph. In dealing with the choice of prism material, no mention of the disadvantage of quartz for quantitative work in the $2 \cdot 9 \mu$ region is made. The usefulness of the chapter on colorimetry will be increased by the addition of sections on nephelometry.

One of the best monographs in the volume is the one on Polarimetry by Dr. Heller. A thorough discussion of the experimental technique in the different spectral regions more than compensates for the meagre theory in the beginning. The importance of visual polarimetry is well brought out and it is interesting to learn that "The sensitivity of the adapted eye is not surpassed by any artificial recording device".

Prof. Smyth's article is the shortest in the volume, dealing exclusively with the experimental determination of dipole moments and the details given are enough for any one to build the necessary apparatus.

The chapters on Conductometry and Potentiometry give useful and clear accounts of the topics though a fuller treatment of non-aqueous solvents is desirable. Muller's account of Polarography is an adequate introduction to an organic chemist contemplating the use of the polarograph besides indicating systems where there is paucity of studies. The chapter on Magnetic Susceptibility is not up to the standards of the rest of the volume.

The chapter on Radio-activity, no doubt, gives a useful account of the methods of measurement but the organic chemist is equally interested in methods of introduction of radioelements into his systems. It is hoped that later editions will give adequate attention to this aspect as well.

One of the late comers in the field of tools for the organic chemist is the Mass Spectrograph, not the least important cause being the enormous cost of the instrument which places it beyond the reach of most organic laboratories. The successful use in tracer work in American laboratories bring this technique into prominence.

There are a few misprints in this well got-up publication, *e.g.*, "*a cross-section* of 0·5 to 1 *c.c.*" on p. 1223, which has escaped correction. There is no author index and the subject index at the end of this volume covers both the volumes. The index will be more useful if each volume has its own or the common index appears in both volumes as in Taylor's *Physical Chemistry*.

The volume will be found useful by advanced students of the Physical Sciences though the price (not mentioned in the volume) judging from a bookseller's list, will be beyond the reach of the average student of this country.

S. V. ANANTAKRISHNAN.

* Vol. I was reviewed in this Journal, 15, p. 86.

An Introduction to the Chemistry of Cellulose. By J. T. Marsh and F. C. Wood. Third Edition. (Chapman and Hall, Ltd., London), 1945. Pp. xi + 525 + xiii plates. 32*sh.*

The appearance of the third edition of this very useful book within a short interval of the second edition demonstrates the need of such books dealing with accurate information on a progressive scientific subject. The authors have done an admirable job in bringing this book up-to-date with regard to several aspects of cellulose chemistry and its industrial application. The insertion of sections dealing with the chemistry of wood pulp and paper and many other additions has increased the size of the book by 42 pages as compared with the second edition. With an exception of minor changes and omitions, most of the matter from the previous edition has been incorporated in the present edition.

Perhaps, the book would have been all the more useful from the point of view of the student and the research worker, if the subject-matter instead of being presented as a collection of reference (at least that is the impression one gets after reading several of the later chapters) had been more critical and explanatory. To those with certain amount of experience and study of the subject, the book can serve as a valuable source of scientific information on the subject.

The general arrangement of the chapters is satisfactory in that it provides a good general background for the detailed considerations of the various developments that have taken place during the recent years.

A few misprints and inaccuracies occur in the text. For example, Venkatraman is spelt as 'Venkatrama' and on page 298, description

of the back titration method for estimating carboxylic acid groups in cellulose gives the impression that the method was originally developed by Nabar, Scholefield and Turner and not by Neale.

The book should find a useful place in the library of every scientific institution and cotton mill.

G. M. NABAR.

The Cathode-Ray Oscillograph in Industry. By W. Wilson, D.Sc. Second Edition Revised. (Messrs. Chapman & Hall, London, W.C. 2), 1946. Pp. xii + 244. Price 18*sh.* net.

This is the second edition of Dr. Wilson's well-known book. It is divided into 12 chapters and is copiously illustrated with beautiful photographs, diagrams and graphs. The first three chapters deal with general principles and a description of the oscillograph and its auxiliary circuits. The next chapter deals with the modern types of oscillograph. This is followed by six chapters dealing with the applications of the oscillograph. The illustrations are drawn from a very wide field and are quite representative. The last two chapters deal with the electron microscope and the operation and maintenance of oscillographs respectively. The inclusion of the description of the electron microscope is most welcome and useful. The principles are essentially the same. Since both the oscillograph and the electron microscope are widely employed in industry, everyone needs a book on both and the inclusion of a description of both increases the utility of the book. But this makes the title of the book a little unhappy. In the opinion of the reviewer, it would be more appropriate to call the book, "The Cathode-Ray Tube in Industry". In the appendix are given a description of thermionic valves, photo-cells, oscillators and piezo-electric crystals. The description is very sketchy. The main portions of the book cannot be understood properly by a person who is not familiar with the basic principles of electronics and, if the same were attempted in the appendix, it would have become very large. Therefore, it would be very desirable to drop this part of the appendix in the later editions. Similarly, the description of high vacuum pumps in the main body of the book may be deleted in a later edition.

This second edition has more matter than the first and parts have been revised. Descriptions of the miniscope, the electronic switch, the cathode-ray fault finder, steel sorting apparatus, strain gauge, etc., are new. More details have been added to the description of echo detection, etc. The chapter on the electron microscope has been made up-to-date.

On the whole, it is a very well written book giving a very authentic and accurate account of the applications of the oscillograph to civil, electrical, radio, metallurgical and mechanical engineering and to physics. The book should find a place in the libraries of science and engineering colleges. Quick and ready methods of testing materials using the oscillograph are now being developed and standardised and, in view of this, the book will be found most useful to all interested in routine testing.

S. V. CHANDRASHEKHAR AIYA.

Electric Discharge Lamps. By H. Cotton. (Messrs. Chapman & Hall), 1946. Pp. 435 + xvi. Price 36*sh.* net.

There are twelve chapters in this book. The first nine chapters deal with different branches of physics, a knowledge of which is necessary for the understanding of the design, construction and the operational principles connected with the various types of discharge lamps. The last chapter is a summary of the known facts relating to colour, its measurement and standardisation. The presentation in all these chapters is mostly simple and does not involve any difficult physics or mathematics.

Only two chapters may be said to deal with the subject proper. Nevertheless the various forms of discharge lamps that are being used in actual practice are very fully described and their operational details clearly presented. Useful technical data are furnished. The principal ones in use are the sodium, neon and mercury discharge lamps and their relative merits have been discussed. The book is a valuable contribution and is likely to be of great help to the Illumination Engineer as well as the physicist.

S. B.

The Indian Ecologist. Edited by Dr. F. R. Bharucha. (Indian Ecological Society, Royal Institute of Science, Bombay 1). Rs. 8 per volume for members.

No one will pretend that the science of Ecology has been accorded its rightful place in our country. Little is it realized that a thorough Ecological survey is of immense assistance in the task of implementing our gigantic plans for the rehabilitation of Agriculture and Sylviculture. And yet Ecology is a comparatively new enterprise with us. The Journal under review is a maiden attempt to mobilise interest in this important branch of knowledge and, therefore, provides a much-needed forum for the co-ordination of the different facets of Ecological Science.

The first number embodies discourses on a wide variety of topics and this is a happy augury for the future. In the opening paper extensive data are provided to show the differences in the micro-climate of our important crops. This is an aspect which has received little attention among Indian Ecologists and the present contribution indicates the possibilities for future investigators. One would wish, however, that there was a wider reference to plant communities in the Indian forests. Then there is a stimulating paper on "Contour Strip Cropping" as a devise for soil conservation. Studies on the adult Trichoptera reveal how ecological studies may serve as indices of evolutionary trends.

It will be admitted that the cost of the publication borders on the prohibitive but we are assured that this is a temporary phase consequent on the present abnormal conditions. The get-up is excellent and attractive and the Journal needs warm support and encouragement.

K. V. S.

D.D.T.—The Synthetic Insecticide. By T. F. West and G. A. Campbell. (Chapman and Hall, Ltd.), 1946. Pp. 301. Price 21*sh.* net.

This publication is an exhaustive review of the World literature on D.D.T., now very extensive and widely scattered. The extremely varied and complicated researches on a bewildering variety of aspects of use of this synthetic insecticide for medical, health, veterinary, agricultural and horticultural purposes, reviewed in this book, present the results derived up to the autumn of 1945 and should therefore be considered to be very up-to-date.

Few developments during the last decade have stirred the imagination of mankind more than the spectacular achievements made possible by the liberal use of D.D.T. for Military needs both at the home and Field fronts.

Rt.-Hon. Winston Churchill in his broadcast of September 28, 1944, said: "We have discovered many preventives against tropical diseases, and often against the onslaught of insects of all kinds, from lice to mosquitoes and back again. The excellent D.D.T. powder which has been fully experimented with and found to yield astonishing results will henceforth, be used on a great scale by the British Forces in Burma and by the American and Australian Forces in the Pacific and India in all theatres." Recently the possibilities of post-war developments in its use for peacetime problems have also fully been investigated and been found to be enormous.

When D.D.T. was first made in 1874 or when it was again reviewed in 1939 by J. R. Geigy, S. A. of Basle—Switzerland, who found that it killed bugs and checked a plague of potato beetles, little did he or any of his collaborators dream that the material bid fair to assume a revolutionary importance in all fields of human activity in a remarkably short space of time.

The fourteen chapters—apart from the Prologue and the Epilogue, of which this book on D.D.T. consists, deal in great detail with such extremely important and instructive topics as: The Original Basle Researches; Manufacture and Chemistry; Principles of Formulation; Toxic Manifestations; D.D.T. in Paints and Miscellaneous Materials; D.D.T. against Human Lice; D.D.T. against Mosquitoes; D.D.T. against Household Pests; D.D.T. against other Pests affecting Men and Animals; D.D.T. against Plant Pests; and Miscellaneous Uses of D.D.T.

The authors point out rightly that "even in these days of intensive research, it is an unusual experience to witness within the short period of one decade, an original discovery pass through all its laboratory stages of test and trial, to develop into a major factor of change. This is the story of dichloro-diphenyl-trichloroethane—D.D.T."

The intensive and extensive investigation on the several different physical forms in which D.D.T. can be used to meet all manner of conditions; its particularly potent characteristic of persistence over long periods and the wide possibilities of incorporating it in certain manufactured materials where temperatures do not rise too high in the process, as also the finding of the effective concentrations at which D.D.T. should be applied to derive maximum benefit, together form a chain of work of an army of researchers, which the authors have very ably and lucidly presented to the scientific worker and the intelligent reading public. Special efforts have been put forth by the authors in collecting and analysing the experiments carried out over a wide range, in the matter of proving, that, at working concentrations, D.D.T. is reasonably "safe" to man, while being absolutely "killing" to the insect enemy. In this connection the authors state that "The position to-day is, however, still to be recognised as experimental. While the Military authorities have been so well satisfied with the applications of D.D.T., already worked out and applied under so many varying conditions, it must be assumed that there are new conditions affecting civilian applications; much will be learnt, therefore, from the wider and large-scale practice of the present and future years".

The possibilities of the use of D.D.T. in paints, textiles and paper, have opened up an entirely new field of operation, the scope of development in this direction being almost unlimited. Perhaps, the most potent check to the activities of disease-carrying insects like the fly, has been, this wonder synthetic insecticide —D.D.T.

Pressing military needs, encouraged by very successful results of varied experiments carried out by a host of scientists, enlisted this insecticide for large-scale use in operational theatres, in refugee camps and a number of other front-line situations; the repercussions have been to say the least, amazingly satisfactory. One would, however, wish that the same could be said of D.D.T. where its use in combating the army of serious insect pests of food and other crops is concerned. This field of work is comparatively new and notwithstanding the vast amount of tests already made in different countries, with D.D.T., the stage has not been reached when it could be looked upon as the 'saviour' of man against 'crop-pests'. Most of the researches carried out in this direction have been of the 'laboratory' size only. Priorities for large-scale field tests against crop-pests, have rarely been available during the pendency of the war; war being now finally over, the present and the future will certainly offer the necessary facilities for harnessing D.D.T. to larger and assured uses in our constant fight against hundreds of varieties of destructive insects. But one factor that looms large and keeps scientists worried in this matter is, undoubtedly, the presence, in nature, of hosts of "beneficial insects" dispersed among "destructive insects" in an almost perfect balance; where D.D.T. is concerned, both groups of the insects are alike susceptible and if the very finely balanced state of existence in nature of these two groups is to be upset, if not destroyed, the outcome appears difficult to evaluate at this stage; the least that could be said about it is that such a thing would be hardly desirable. What makes D.D.T. a "dreaded stuff" is its "residual action"; while this property is extremely welcome in the case of combating the destructive insect pests, in the matter of preservation of the beneficial insects,

it might prove positively dangerous—a contingency that all believers in well established natural phenomena would always like to avoid. With reference to this matter the authors pertinently state that while D.D.T. offers great hope in the tremendous field of plant-pests, for more efficient methods of controlling some of them, there goes with this possibility the challenge of its effect on beneficial insects. With an insecticide of such scope and power, as D.D.T., it is to be expected that extreme care will be necessary in meeting the dangerous by-effects which are inevitable with most worth-while discoveries. The overcoming of this problem may lead to work on the possibility of spraying at carefully selected times or under special conditions, which, quite apart from D.D.T., may stimulate fruitful lines of research. A tremendous field awaits the formulator of emulsions—whether the emulsions should break quickly; whether the D.D.T. should be dissolved in a solvent (before emulsification) which would be likely to evaporate or otherwise deposit D.D.T. It is now generally recognised that the exact physical form in which the insecticide is made available to the insect, is of paramount importance."

The authors attach a most interesting Epilogue to their book, in which, characteristically enough, they close their worthy efforts at reviewing the varied and extensive researches on D.D.T. by declaring their belief in D.D.T. enabling, in future years, millions of backward peoples in remote parts of the world to live longer and in a better state of health.

The publishers deserve great credit for having spared no efforts in making the book extremely handy and attractive.

Report of the Scientific Advisory Board for the year 1st January to 31st December 1945. Issued under the authority of the Governing Body, Indian Research Fund Association, New Delhi. (The Secretary, Governing Body, Indian Research Fund Association, Secretariat, New Delhi.) Pp. 164. Re. 1.

The Annual Report of the Scientific Advisory Board for 1945 sets out in a succinct manner the various and varied activities of the Indian Research Fund Association in the sphere of medical research. Reports of the Advisory Committees on Cholera, Malaria, Nutrition, Plague, Clinical Research, Maternity and Child Welfare, Rabies and Industrial Health are also incorporated. Results of work on the treatment of cholera with sulphaguanidine and the statistical evaluation of the data on anticholera inoculation are included as also a note on the preparation of a new cholera vaccine and a method of testing the potency of cholera vaccines. Investigations with various insecticides and mosquito repellants, and studies on mammalian malaria are reported.

Nutrition continues to be a major subject of research of the Indian Research Fund Association and the schemes financed during the year embrace a wide field covering both the theoretical and practical aspects of nutrition. The vexed question of the comparative nutritive value of animal *vs.* vegetable fat, and animal or vegetable fat *vs. vanaspati*, the methods of treating sick starving destitutes, evaluation of proteins in terms of hæmopoietic activity, etc., have been investigated during the year. A fairly detailed account of the progress of nutrition work in the Provinces and States is included. Clinical Research takes up a good slice of the Report and the proceedings of the first meeting of the Clinical Research Advisory Committee constitute interesting reading. The budget allotments for the 48 enquiries, financed by the Association, and for the publication of the *Indian Journal of Medical Research*, appear towards the end of the Report. Those interested in the progress of medical research in India will find the Report extremely useful and informative.

S. RANGANATHAN.

Studies on Protein, Fat and Mineral Metabolism in Indians. By K. P. Basu. Special Report, I.R.F.A., No. 15. (The Job Press, Cawnpore), June 1946. Pp. 64. Price As. 12.

This is a review of the activities of a group working as a unit in the Biochemical Laboratory of the Dacca University under the auspices of the Indian Research Fund Association and embodies the results achieved during a space of eight years on a rather difficult and tedious problem of metabolic studies on human experimental subjects. The investigations include a study of the intake and excretion of proteins, fats and different minerals by apparently normal adults. The minimum daily requirements of the various dietary constituents have been determined and the adequacy of typical Indian dietaries with regard to these factors have been investigated by actual metabolic experiments. The effect of cheap and easily available supplements in making good some of the deficiencies, particularly that of calcium, has been studied. The mutual influence of minerals in metabolism and the role of vitamins in the metabolism of the various minerals have also been investigated. Stress is rightly laid on the need for knowledge of the metabolic processes in the normal individual before deviations from the normal as also pathological changes can be appreciated and evaluated.

While most fats and oils, animal and vegetable, have a high digestibility coefficient, *vanaspati* has a comparatively lower absorption coefficient. This is explained as due to the raising of the m.p. of the fatty acids during hydrogenation. The author pleads for fixing an upper limit (preferably below 40°) for the m.p. of hydrogenated fats and oils which the manufacturers should not be permitted to exceed. Looking at Table XIII on p. 20 with a daily negative balance of 113·9 mg. of Ca and a corresponding positive balance of 305·1 mg. of P on a coconut oil diet, one is tempted to wonder at the fate of the millions of inhabitants of the West Coast of the Madras Presidency to whom coconut oil is perhaps the only source of fat; they are apparently none the worse for it.

The results of metabolism experiments get somewhat complicated with negative balances observed on numerous occasions. Percentage retention calculated on the basis of a so-

called improvement, from a bigger negative balance, does not appear to be quite happy. A useful bibliography is included. The Report contains ample evidence of hard and painstaking work put in the elucidation of a rather intricate problem in human metabolism.

S. RANGANATHAN.

Food Control and Nutrition Surveys (Malabar and S. Kanara). By K. G. Sivaswamy and others. (Servindia Kerala Relief Centre, Royapettah, Madras), May 1946. Pp. 225. Rs. 4-0-0.

The Servindia Kerala Relief Centre have recently put out a number of publications on the appalling conditions of the people of the West Coast of the Madras Presidency brought about by the present food distress. The book under review is one such and deals with the conditions of food control and nutrition surveys in Malabar and S. Kanara. The effects of food scarcity on public health have been assessed by a band of eleven doctors and the results set out as also the working of measures of food and price controls. The surveys begin with two statements issued by the Hon'ble Dr. Pandit H. N. Kunzru, President of the Servants of India Society, and Member of the Central Food Advisory Committee. This is followed by two articles by the late Mr. V. R. Nayanar on famine, cholera and orphanages. Mr. L. N. Rao has contributed an article on the food of the Malabar aboriginals based on his own enquiries and those of the teachers at Chelode. This is followed by a critical analysis by Mr. K. G. Sivaswamy of the food distress and the various control measures introduced by the Government of Madras during the last four years. A number of useful appendices is included which give data regarding family dietaries, medical and nutritional surveys, vital statistics, etc.

A section of the book deals with food and price control in S. Kanara by Dr. Kakade, the chronology of food events and a nutrition survey by Dr. Bhat. The chronology of food events constitutes interesting reading and shows how the prices of agricultural products soared to dizzy heights in January 1943.

The book contains much useful information, painstakingly collected but unfortunately not happily marshalled. Mistakes are comparatively rare, a glaring one being on the first page 67, "12 ounces of rice supplied only about 100 calories". While on this point, the reviewer cannot help giving vent to his feelings of revolt at the pagination of the book. A mere perusal of the contents of the book will at once show that pages 1 to 65 occur thrice. Reference to pages becomes obviously difficult and complicated. This is not the first instance that the publishers revel in such confusion in pagination. An anomalous "Introductory" appears in the middle of the book, after the second 84th page, the pages of which are numbered in Roman letters.

S. RANGANATHAN.

Inadequate Diets, Deaths and Diseases and a Food Plan for Madras. By K. G. Sivaswamy and others. (Servants of India Society, Royapettah, Madras), May 1946. Pp. 72+11. Rs. 2.

The author examines the number of excess deaths in the province of Madras during the period of food scarcity, 1943-44 and the causes of such deaths. Most of the deaths were due to cholera, small-pox, malaria and such nutritional diseases as dysentery, diarrœha, etc. A study of 4,500 patients in the coastal areas between Cape Comorin and Mangalore during the early part of 1945 showed a preponderance of anæmia, scabies, digestive troubles and nervous diseases. The diets consumed in the different areas and their deficiencies have been critically studied. An instructive note on nutritional diseases and certain food hints based on traditional knowledge are also included. Informative notes on the diets of natives in the islands of the Indian Ocean, of S. Africa and S. America, and of the inhabitants of occupied Europe are appended. The relation of an excessive carbohydrate food to œdema, anæmia, ulcers and nervous diseases is discussed. A food plan for Madras which aims at correcting the prevalent diet deficiencies is recommended by the author. Due note has been taken to supply protective foods to the more vulnerable groups of the population. The author has examined certain short-range programmes for increasing food production and has put forth small schemes for conservation of rain water, expansion of the fishing industry and improved methods of goat-breeding by artificial insemination. The book contains much useful information and extremely practical suggestions calculated to tide over the present food crisis.

S. RANGANATHAN.

SCIENCE NOTES AND NEWS

Adam Hilger, Limited.—On June 30th, 1946. Mr. Frank Twyman, F.Inst.P., F.R.S., resigned his position as Managing Director of Adam Hilger, Ltd., which he has held since 1902, to become Technical Adviser to the firm and to their associates, E. R. Watts & Son, Ltd., the well-known makers of Surveying Instruments. Mr. Twyman remains Chairman of Hilger's.

His place as Managing Director is taken by Mr. G. A. Whipple, M.A., M.I.E.E., F.Inst.P. Mr. Whipple, who is also Managing Director of Watts, is the son of Robert S. Whipple, Chairman of the Cambridge Instrument Company.

Mr. Twyman came to Hilger's in 1898; he became Manager of the firm on the death of Mr. Otto Hilger in 1902 and Managing Director of the Company on its incorporation in 1904. Under Mr. Twyman's direction the firm has

specialised in the manufacture of optical instruments for research in physics and chemistry and for the control of industrial processes.

The instruments put on the market by the firm during that time have contributed not a little to knowledge in atomic and molecular physics and have brought optical glass work to a higher level of perfection, not only in this country, but in the world generally.

In recognition of the value of these instruments, many of them designed by Mr. Twyman himself, he was in 1924 elected a Fellow of the Royal Society.

Mr. G. A. Whipple, after graduating at Cambridge, carried out research work in Germany and in this country. He has served on the Council of the Institution of Electrical Engineers and has been Hon. Secretary of the Scientific Instrument Manufacturers' Association for the last six years. He is a member of the Boards of Governors of Northampton Polytechnic and the National College of Horology.

It is intended that Hilger's should continue to pursue the same policy as heretofore, but on a larger scale, made possible by combining the productive and technical resources of the two firms.

Andhra University: Award of Research Degrees.—On the recommendation of the Board of Examiners consisting of (1) Prof. M. Born, M.A., Ph.D., F.R.S., Department of Mathematical Physics, the University of Edinburgh, (2) Dr. E. C. Bullard, Department of Geophysics, the University, Cambridge, and (3) W. A. Wooster, Esq., Department of Crystallography, the University, Cambridge, appointed to adjudicate on the thesis "Studies in Ultrasonic application to Elastic Constants of Substances", resolved that Mr. J. Bhimasenachar, M.Sc., be declared qualified for the Degree of Doctor of Science (D.Sc.).

On the recommendation of the Board of Examiners, consisting of (1) Prof. Sir Ian Heilbron, D.S.O., LL.D., F.R.S., Imperial College of Science and Technology, London, (2) Prof. A. R. Todd, D.Sc., F.R.S., Cambridge, and (3) Prof. G. A. R. Kon, M.A., D.Sc., F.R.S., the Chester Beauty Research Institute, London, appointed to adjudicate on the thesis "A Study of Some Vegetable Colouring Matters and Related Compounds", resolved that Mr. V. Venkateswarlu, M.Sc., be declared qualified for the Degree of Doctor of Science (D.Sc.).

Nuffield Foundation Fellowship and Scholarships for the Advancement of Extraction Metallurgy.—Notice has been received that the Nuffield Foundation, which has already done much to aid medicine, has just inaugurated a scheme with the object of advancing research and training in extraction metallurgy. The scheme is in three parts:—

(*a*) Five Travelling Fellowships are being offered each year to members of the teaching staff of universities and approved schools of mines and metallurgy within the Commonwealth and Empire. The object of this scheme is to enable teachers to visit important mining and metallurgical centres in the Empire in the long vacation in order to study the methods employed in those centres. The value of each fellowship will be up to £500 including the cost of travel. The duration of each fellowship will be approximately three months.

(*b*) Five Travelling Post-Graduate Scholarships are being offered each year for junior long vacaion in order to study the methods members of the profession who are graduates of universities and approved schools of mines and metallurgy in the Commonwealth and Empire and who have specialised in extraction metallurgy. Candidates will be selected not necessarily on account of their order of merit in examinations, but with regard also to their personality and general suitability. The value of a scholarship will be up to £500, including the cost of travel. The duration of a scholarship will not usually exceed six months.

(*c*) Ten Vacation Scholarships for students of mining and metallurgy at universities and approved schools of mines and metallurgy within the Commonwealth and Empire, to enable them to travel by air to important mining and metallurgical centres for vacation work. The value of a scholarship will be up to £200 to cover the cost of air travel.

The scheme has been drawn up in co-operation with the Institution of Mining and Metallurgy, which Institution will continue to assist the Foundation in the operation of the scheme.

Forms of application for scholarships may be obtained from the Secretary, Nuffield Foundation, 12|13, Mecklenburgh Square, London, W.C. 1.

Fertilizer Factory.—The proposed Rs. 10½ crore project for establishing a Fertilizer Factory at Sindhri in Bihar, which is expected to produce 350,000 tons of ammonium sulphate per year, is now well under way.

The supply of specialist plants, such as boilers, gas compressors, gas plant, turbo-alternators, etc., have been ordered from abroad at a cost of nearly Rs. 3 crores. Certain other categories of heavy plant must also be imported owing to lack of facilities for manufacture of the plant in India.

A good deal of other items can be fabricated in India and the Government of India have decided that as much as possible of such requirements should be manufactured and supplied indigenously. These items cover a wide range of plant and machinery, such as structural steel, cranes, tanks, steel water mains and certain classes of electrical equipment, etc. Opportunity is now open to Indian producers to manufacture and supply their products.

Dr. S. L. Hora, Director of Fisheries, Bengal, has been elected as one of the fifteen Honorary Foreign Members of the American Society of Ichthyologists and Herpetologists.

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CURRENT SCIENCE

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PEOPLE'S HEALTH AND STATE'S RESPONSIBILITIES*

NEITHER the Interim Government nor the Provincial Ministries had any part in the appointment of the Bhore Committee. Perhaps this is an advantage as we can bring impartial judgment to bear in our discussion of the Report. We can all agree, however, that a comprehensive survey of this kind was necessary and we are thankful to Sir Joseph Bhore and the members and secretary for the diligence and thoroughness with which they discharged their immense task. As far as I am aware in no country except South Africa has such a comprehensive review of the health services been undertaken and few committees have been faced with such an extensive field of enquiry. The survey of present conditions which has been given in the Report should be studied by all who are in any way connected with, or interested in, health administration and health conditions. No one can read it without being convinced of the most urgent need for an effective programme to improve the health of the people.

The facts of high mortality, sickness and disease and the inadequacy of our hospitals and health services have of course long been known to us in a general way. We read frequently enough of the progress of epidemics which would be startling in their magnitude if we were not so accustomed to them. Wherever we go in town and village, the defects of our sanitary services come to our notice only too often. Our high death rate of 24 as compared with 11 in other countries and our appalling infantile mortality rate of 169 per thousand births have frequently been published. But I think we needed a review of this kind to bring home to us how serious the position is and how rudimentary and inadequate our services are, to compel us to cast off apathy and indifference and to stir us to activity.

State's Responsibilities

There was a time when health was regarded as being largely the personal concern of the individual. That conception still lingers, but we have travelled far from the days of *laissez faire*. It was the ravages of an epidemic disease which first compelled the State to intervene. In India the great plague epidemic of the nineties led to the setting up of the Plague Commission and the development of public health organizations in some of the larger towns. The latest example is the great cholera epidemic following on the famine in Bengal which provided the incentive for a considerable improvement in the medical organization, and to a lesser extent in the public health services, in that Province. Such stimuli, however, are to some extent fortuitous and are apt to be transient. In recent times a more permanent and a more effective incentive comes from the growth of social consciousness, of democratic ideals and of a new conception of social welfare and of the rights and duties of the individual and the responsibilities of the

*Extracts from an Address delivered by Sir Shafaat Ahmad Khan, Member for Education, Health and Arts, to the Conference of Health Ministers, on 10th Oct. 1946, at New Delhi.

State. It is now accepted that health is one of the goods of life to which man has a right. He has a right to those conditions of living in which health can be achieved and maintained and, when he is ill, to the medical treatment necessary for his recovery. Health like education, must, therefore, become a function of the State. The objective of the State must be to create the conditions for healthy living, to provide as complete a health service as possible and to include within its scope the largest possible proportion of the community. In India it will take a long time to realise these aims owing to the paucity of our financial resources and our large population but the Centre is prepared to take an active part in promoting them with the help and co-operation of the Provinces.

A large proportion of our people are living below the normal level of subsistence and the State must provide for them the medical benefits for which they themselves are unable to pay. As far as our resources permit we should avoid imposing a "means test" and should make our medical services accessible to all without distinction.

A spur to action should be the realisation that a disease-ridden community cannot be a prosperous community. The President of that great and wealthy country, the United States, has said that the United States could afford many things but ill-health was one thing they could not afford. The Bhore Committee has put the matter in another way in saying that a nation's health is perhaps the most potent single factor in determining the character and extent of its development and progress. Certainly no development programme can be complete or effective without adequate provision for measures of improving the health of the people.

Influence of Environment

I will not attempt to cover the whole field of the Committee's report but I should like to refer to two or three matters on which the Committee has rightly laid emphasis and which, self-evident though they may be, are as yet imperfectly understood. The first is the influence of conditions of living and environment on the health of the individual and the community. It is idle to talk of health to a person whose cereal ration is far below the standard necessary to maintain normal health and vigour; or to persons living ten in a room in a slum tenement; or to those who through poverty are unable to obtain the essential necessaries of life. Health is indeed affected by the whole of man's environment, by the conditions in his home, at school and at his place or work, by his economic condition and security of employment. It follows that the responsibilities of those of us who are concerned to any degree with the health of the people extend far beyond the hospitals and it is necessary that we should take an interest in all those Government or social activities which promote health or might be used to promote it. There are Government and municipal activities which have been, and are still being, carried on without relation to, or even to the detriment of, the needs of national health. I need only refer to road and railway construction which has often through faulty design led to an increase in malaria. Private enterprise also is frequently responsible for practices which are inconsistent with national health. If we are to improve our national health all our Governmental and social activities must be reviewed from the point of view of their effect on normal health.

Preventive Measures

Another matter which the Committee emphasises is the need for an improvement in environmental hygiene, and preventive measures generally, if a substantial improvement in health is to be secured. They have pointed out that unless we can clear up our towns and villages and provide a safe and adequate water supply they will continue to be factories of ill-health which will fill all the hospitals we can provide. If we look to the West we find that the fall of 50 per cent. in the death-rate which occurred in the second half of the last century has been attributed largely to the improvement in sanitary conditions. A safe water supply, an efficient system of scavenging and refuse disposal and in the towns adequate sewerage have long been recognised as the primary necessaries of civilised life in any community. But they are necessities in which we in India are still deficient. Even in some of the largest towns, the sanitary organisation is notoriously inefficient, while in the rural areas there has been in most Provinces no systematic attempt to improve sanitary conditions. If there is a question of priorities—and planning means priorities—I think all will agree that an active programme for the improvement of water supply and sanitation in our towns and villages is one of the most urgent of our needs.

Another equally important item in the programme for the improvement of living conditions is that of housing and the planning of our towns. That is a subject of considerable complexity and difficulty and will I think have to be dealt with at a special conference. As a preliminary to an inter-Government discussion I propose, if the Provincial Governments agree, that it would be useful to call a conference of Chairmen of Improvement Trusts and Development Boards. Then there is of course the whole field of preventive medicine. The development of modern science since 1880, the discoveries of Pasteur, Koch, Manson and Ross and countless other workers, by revealing the cause of disease and its process, has given us the knowledge without which all efforts at prevention or control are at best empirical. I will refer only to one disease—malaria. Here we have a disease which is not only the direct or indirect cause of tremendous mortality but is also responsible for an incalculable amount of disablement. No one can deny that if we could get rid of or control this disease we should substantially increase our national productivity and vitality. Science has revealed to us not only the cause and the method of transmission of the disease but has placed in our hands powerful larvicides, insecticides and drugs. It remains for us to find means for effective application of the knowledge made available to us. Control is expensive but it pays dividends and I am confident that with

enthusiasm and determination, by planned experiment and a resolute search for economical methods of control a large measure of success can be achieved. Most Provinces have included anti-malaria schemes in their plans although some of them are on a very meagre scale. An exception is Bombay which plans to control malaria over two whole districts with a population over one million. There is another particularly important aspect of malaria control. As you are aware the incidence of malaria has often been greatly increased through engineering works by faulty design of culverts, by inadequate provision for drainage and by excavation of burrow-pits. It is imperative that the creation of this man-made malaria should be avoided in the big programme of railway and road construction which lies ahead. A committee of experts has been set up to recommend what measures should be taken to avoid creating conditions favourable to the spread of malaria and I hope we shall have its report in the near future.

EPIDEMICS

While speaking of prevention I should like to refer to the measures for dealing with epidemics. We are still visited by great epidemics of cholera, smallpox and plague. In the cholera season three to four thousand deaths a week is not unusual. While eventually as our health programme develops it should be possible to reduce these preventable diseases to small proportions, there is in the meantime a need for more vigorous measures to check epidemics in the early stages and to provide treatment for those who have the misfortune to be attacked. This is a matter in which the Government of India are particularly interested as they are concerned with the spread of disease from one province to another. Disease does not recognise provincial or any other boundaries and in this matter Provinces have a duty not only to their own people but to their neighbours.

I have suggested two priorities—sanitation and malaria. As a third I suggest the provision of health services in the rural areas. As one who comes from rural stock I know well how neglected these areas have been in the past. We have here and there a few dispensaries, mostly inadequately staffed and equipped; there may be a sanitary inspector with an area in his charge so large that nothing substantial can be achieved; but as the Bhore Committee says, "it is only the outermost fringe of such public services and amenities as the country enjoys that occasionally comes within the orbit of the cultivator's daily life". I do not suggest that we should neglect the towns where, indeed, mortality and sickness are often even higher than in the countryside. But after all over 80 per cent. of our people live in the rural areas and the time has come for an effective programme to bring the benefits of modern medical science within the reach of the cultivator. The Bhore Committee has suggested for this purpose the development of a district health organization with a primary health centre for every 40,000 people, a thirty-bed hospital for every 200,000 and a secondary centre with a 200-bed hospital for each district. This is not I think an extravagant programme to be carried out over a period of ten to twenty years, and is, I understand, the minimum organization which the Bhore Committee considered to be necessary to provide a reasonably effective, curative and preventive health service. The question of implementing this recommendation is one of the items on our agenda.

LOCAL SELF-GOVERNMENT INSTITUTIONS

Whatever organization may be adopted, I have no doubt that both in the rural areas and the towns it must be organically related to our local self-government institutions. Our local bodies have their defects; they are known only too well to all of us. But they are our safeguard against bureaucracy; and bureaucracy means routine, centralisation, the loss of adaptability to changing conditions and leads eventually to authoritarianism. Moreover, as the Bhore Committee has pointed out, a health organization can attain its objective only with the co-operation of the people themselves. The people themselves must take an active part in the protection of their own health through self-governing bodies in rural and urban areas which reflect the needs of the individual citizen. Our problem is to secure a minimum standard of efficiency. The Bhore Committee's solution for co-ordination of the health administration with local self-government and for securing an efficient health administration is one of the matters we have to discuss.

TRAINING OF PERSONNEL

The training of personnel is evidently a matter which must be given special attention in the early years of development. The building up of training institutions takes time, while the training of medical officers and some other categories of personnel takes some years. Unless adequate provision is made in the early years therefore, development in later years will inevitably be hampered. There are at present only about 47,000 qualified doctors in the country. The Bhore Committee has estimated that for the first five years of their scheme an additional 15,000 medical men will be required. The number of nurses requires to be doubled or trebled even to provide an adequate staff for existing institutions. The number of midwives is at present about 5,000 whereas it is estimated that for an adequate maternity service something like 100,000 would be required. These figures give some indication of the dimensions of our problems.

There are, of course, many other matters which require consideration. There is nutrition and the question of school feeding which has given such good results in other countries. There is the question of school health services. There are the maternity and child welfare services. These services hardly exist in India at present. When we recall that nearly 25 per cent. of the deaths among the people of India take place among children in the first year of life and that the corresponding percentage in the United Kingdom is six, the need for maternity and child welfare services is clear. There is the question of industrial health services and health insurance. A report by a scientific worker under the Medical Research Council which is being circulated to you will give some indication of the urgent need in the field of industrial health. There are the important proposals of the Committee relating to medical

education which have been referred to the Medical Council of India for their opinion There are the problems of special diseases such as tuberculosis, venereal diseases and leprosy. These and other matters will, I hope, be subject for discussion at a future conference.

Question of Expenditure

Then there is the matter of finance. We must face inescapable realities and one of these is the limitation imposed by our resources. But I have no doubt that if we are serious in our desire to build up the people's health and do not pay mere lip service to an ideal, we must devote a larger part of our resources to health. The pre-war average of expenditure on medical relief and public health was about 5 per cent. of the total expenditure or about 5 annas per head. In Ceylon the corresponding figures were 10 per cent. of the total expenditure and Rs. 2 per head of population. The Bhore Committee has suggested that the amount of Government expenditure on health should be increased to at least 15 per cent. of the total expenditure. Provincial Governments have already been informed of the assistance that is likely to be available to the Provincial Governments from the Centre in the form of general development grants but this assistance will be of little avail unless there is a substantial increase in the provision for the health services from provincial resources.

Central Government's Plans

Before I close I should like to say something of our own plans Detailed plans for health development must of course be made and carried out by Provincial Governments. Our function here is largely to assist by co-ordination, provision of expert advice, and development of activities and institutions which are beyond the scope or capacity of individual Provinces. Within these limitations the Interim Government will do all in their power to assist sound health development in India. The most important recommendation of the Bhore Committee in relation to central activities is that concerning the establishment of an All-India Institute with up-to-date facilities for training and research of the highest standard. I think the conception is a fine one and we propose to pursue the scheme actively and expeditiously. I propose to set up very shortly a small committee to advise the Government on the scheme. We also intend to provide facilities at Calcutta for medical licentiates from all parts of India to enable them to take their M.B.B.S degree and we have taken over surplus American buildings and hospital equipment for the purpose. While we must develop medical education in India as rapidly as possible, we must in the meantime send selected students abroad for higher training. There is no doubt that we have not at present in India the facilities for advance post-graduate training which are to be found in other countries and I hope we shall be able to place abroad, under recognised leaders in the various branches of medical science, at least fifty of our most promising men in each year. There is also a good deal to be said for enabling some of our specialists to go abroad for short periods. Most of our scientific workers have been cut off from contact with workers abroad during the war and I feel that there will be a considerable advantage in enabling some of them to travel abroad, make contacts with scientific workers in other countries and study at first hand recent scientific development. We are expanding the staff and accommodation of the Malaria Institute of India to enable it to play its part in the drive against malaria which, we hope, will be set on foot in all Provinces. In the field of research I have no doubt that far greater assistance must be given than in the past and the proposals of the Bhore Committee are being considered in consultation with the Indian Research Fund Association.

In the field of nursing, in which India is so woefully backward, we are assisting in the higher training of future nursing administrators and specialists by the establishment of a nursing college which will provide a course for a University degree in nursing as well as shorter specialised courses. It is hoped to develop in this institution in due course facilities for training in public health nursing. The legislative proposals for the regulation of the pharmacy profession which are already before the Central Legislature will be pursued and I hope that we shall also be able to introduce similar legislation for the dental and nursing professions. The arrangements for the enforcement of drug standard control, which is of such importance to the country, are in hand and the control will be introduced from the 1st April next. We also intend to develop what I may call the advice and information services. For example a Bureau is being set up with the function of collecting information and advising Provinces regarding the design and equipment of medical institutions. Another subject which is engaging our attention is that of the data relating to population and vital statistics. Vital statistics are the foundation for public health work and there is a great and urgent need for improvement in the quality and speed of collection of such statistics. The growth of population is of course one of our large problems. I will not enter this controversial field now but there is a clear need for the collection and co-ordination of data relating to population growth. This is important not only from the point of view of material for study of the so-called population problem but also from that of long-term planning generally. These are some of the more important activities which we have in view and I hope that we may be able to extend them in directions in which Provincial Governments and Institutions need assistance.

With the establishment of our own National Interim Government at the Centre we have entered the "age of hope". Let us go forward in company to make it the "age of achievement" The building of a Nation's health is no easy task. With our meagre resources we shall not be able to advance as rapidly as we should like; but it is a task worthy of all our energies and devotion. And no task is more important for the national welfare, for without health we cannot have happiness or contentment or prosperity. With co-operation, sustained effort and determination I am confident that we can succeed.

CYCLES IN DHARWAR SEDIMENTATION

BY DR. C. S. PICHAMUTHU
(*University of Mysore*)

NOW that the sedimentary origin of many of the constituents of the Dharwar System in Mysore has been recognised, it is for consideration whether these ancient sediments share any of the characteristics of later formations. There are many aspects of this problem, but attention will be confined here to one of the important features of thick accumulations of sedimentary rocks, namely, the recurrence in cycles of sequences of certain types of sediments.

Sediments usually accumulate to great thicknesses in large subsiding troughs which are called geosynclines, and subsequently these areas become mountain ranges. The general course of events is somewhat as follows: the geosyncline gradually sinks during long ages; this downwarp gets slowly filled in by sediments which accumulate as sinking goes on; the geosynclinal downwarp caused by the accumulation of thousands of feet of sediments in such a basin of deposition results in the rise of the isogeotherms; this produces expansion and lateral pressure as a consequence of which the sediments are folded; further increase of pressure causes overfolds and thrusts, and the final expression of this is orogenesis when the geosyncline is elevated to form a mountain range. Each orogenic revolution is accompanied by abyssal injection and followed by volcanic action.

This sequence of events must undoubtedly leave an impress on the type and structure of the rocks. The nature of a sedimentary deposit has a direct bearing on the depth at which it is formed, and in a subsiding basin, the succession is ordinarily a conglomerate, followed by sandstones, clays, and limestones. In metamorphosed regions, the rock sequence is conglomerates, quartzites, schists, and crystalline limestones. This sedimentary cycle can be observed in several formations of different ages in India, *e.g.*, in the Salt Range and Spiti areas, and in the Cuddapah and Vindhyan formations. The cycle is not often complete or obvious because of the disappearance of strata due to denudation or to tectonic disturbances.

The Dharwars are much more ancient in age, and hence the probability of the preservation of evidences of such sedimentary cycles is somewhat less. It is remarkable, however, that though the Dharwars have been highly disturbed and metamorphosed, the sedimentary sequence in many regions is reasonably clear. In such favourable areas the sedimentary cycle can be recognised.

This succession of quartzites, shales or schists, and limestones is seen in many occurrences of Archæan rocks in the Peninsula. The Aravalli System starts with a basal quartzite and is succeeded by phyllites, and cherty limestones. In the Delhi System, quartzites are succeeded by phyllites and biotite schists which are overlaid by calc-schists and calc-gneisses. In the Gangpur Series, the succession is quartzites, mica schists and phyllites, and dolomitic and calcitic marbles. The Sausar Series commences with a quartzite overlying which are schists, calciphyres, dolomites, and crystalline limestones. In Bastar State, the oldest Pendulner Stage is composed mostly of quartzite; this is overlain by the Bengpal Series which is formed of andalusite-gneiss and cordierite-gneiss which represent metamorphosed aluminous sediments; the Bailadila Iron Ore Series which comes next is formed mainly of calc-schists, amphibolites, and banded ferruginous quartzites. In many other regions, schists succeed quartzites, but the limestones are wanting.

It is interesting to note that in Mysore State also this sedimentary cycle can be recognised. In the Shimoga Schist Belt, both the middle and upper Dharwars exhibit very well the sequence of conglomerate, quartzite, schist, and limestone.

SHIMOGA SCHIST BELT

Upper Dharwars—
Ferruginous quartzites.
Thin bands of limestone.
Agrillitic calcareous silts.
Quartzites.
Conglomerates.

Middle Dharwars—
Banded hæmatite quartzites.
Limestones and dolomites.
Phyllitic and chloritic schists.
Secicitic grits and quartzites.
Conglomerates.

CHITALDRUG SCHIST BELT

Upper Dharwars—
Ferruginous and Manganiferous quartzites.
Chalybitic rocks.
Clay schists and phyllites.
Sandstones.
Conglomerates.

Middle Dharwars—
Banded ferruginous quartzites.
Limestones
Shales, phyllites and schists.
Quartzites and grits.
Conglomerates.

Thus we see that the Dharwar sediments in their order of deposition conform generally to what has been noticed not only in the younger formations but in the analogous rock series in other parts of India. In this respect, the Dharwars of the Peninsula resemble also the Pre-Cambrian formations of China, United States, and Canada.

From what has been said above it is clear that in the Dharwars of Mysore, two distinct sedimentary cycles can be recognised each commencing with a conglomerate which passes on into quartzites (often showing current bedding and ripple marks), and succeeded by shales or schists, and limestones associated with banded manganiferous or ferruginous quartzites.

Epochs of sedimentation have always been followed by intervals of vulcanism. The geological record contains many examples of vulcanism after a period of geosynclinal sedimentation. The earliest records throughout the world bear ample evidences of this, and the sedimentary rocks are seen to be intruded by

and interbedded with igneous material. The Dharwars, again, are no exception to this. In Mysore, as in similar formations in many other parts of the world, the Dharwars start with an igneous complex of basic, intermediate, and acid lava flows and intrusives. Then the middle Dharwar cycle of sedimentation commences. At the closing phases of this cycle, extensive igneous action takes place. Batholiths and stocks of acid rocks have stoped their way upwards and some of them have reached the surface. In the Shimoga Schist Belt we have examples of the granite masses of Rangandurga, Balekal, and Shimoga; and, in the Chitaldrug Schist Belt, the Pitlali and Bukkapatna granites. It is probable that at this stage the sediments were thrown up into huge mountains.

Subsequent to such mountain building activity, minor intrusions and volcanic flows, mainly of the composition of basalts are usual, and in the Dharwars of Mysore we have again good examples of such igneous phenomena. In the Shimoga Schist Belt there are the Bababudan epidiorites, and in the Chitaldrug Schist Belt, the Jogimardi and Bellara traps.

The mountain ranges of this period were then subject to erosion and peneplanation, and the stratified rocks of the second cycle would then have been laid down upon a probably folded and faulted and planed-off body of rocks, commencing with conglomerates and succeeded by quartzites, shales, limestones, and ferruginous quartzites. The same sequence of events must have been repeated, ending again with a period of igneous activity. The granitic rocks which have now been identified as portions of the Peninsular Gneiss, and the hornblendic and norite dykes are evidences of this third phase of vulcanism which marked the close of the second cycle of Dharwar sedimentation.

It will thus be seen that in the Dharwars of Mysore we can recognise at least two distinct cycles of sedimentation each with its attendant igneous phenomena.

FOURTH INTERNATIONAL CONGRESS FOR MICROBIOLOGY

NEWS has been received at the office of the Indian National Committee of the International Association of Microbiologists that the Fourth International Congress for Microbiology will be held at Copenhagen, Denmark, from July 20th to 26th, 1947. The business of the Congress will be conducted through 9 sections, as follows:—

Section I.—General Microbiology; Antibiotica; Growth substances. *Section II.*—Medical and Veterinary Bacteriology; Diphtheria; Pertussis; Pathogenic streptococci; Tuberculosis Brucellosis. *Section III.*—Viruses and Viral Diseases; Poliomyelitis; Influenza. *Section IV.*—Serology and Immunology; Fundamental Principles of Serology, partly in relation to Infection-Biology, partly from physical and chemical view-points. *Section V.*—Variation and Mutation in Micro-organisms; Adaptation; Induced Mutation. *Section VI.*—Plant Pathology and Mycology; Plant pathogenic bacteria —their taxonomy and nomenclature; Nomenclature of plant viruses; Physiologic (pathogenic) races of fungi; Fungus flora and decay in wood pulp. *Section VII.*—Water and Soil Microbiology; Antibiotic activity in the soil; Nodule bacteria and nitrogen fixation in the soil; Microbiological methods for determination of soil fertility; Autotropic bacteria; Methods for quantitative determination of *Escherichia ooli* in water; Pathogenic bacteria in sewage; Bacteriology of the biological purification of sewage. *Section VIII.*—Dairy and Food Microbiology; Sour-milk for therapeutic purposes; Lactic acid bacteria in silage; Food poisoning. *Section IX.*—Alcoholic and other Fermentations; Butanol-acetone fermentation; Food yeast.

The International Society for Microbiology was established in 1930 "with the object of promoting scientific thought by creating a closer relationship between scientific workers in different countries, and especially of spreading the idea that all its members were united in a common ideal of peace and constant friendship."

The Society is directed by a Central International Committee and a Permanent Commission. The Central Committee is composed of members of the Society's Board, the members of the Permanent Commission and the Chairmen of the National Committees.

Each country of geographical region forms a National Committee made up of workers in various universities, research institutes and other institutions concerned. The constitution enjoins that workers wishing to contribute papers must apply for membership through the National Committee of the country concerned and when the Central Committee approves of such application, they then become full members on payment of the required fee. The office of the Fourth International Congress is located at Kommunehospitalet, Copenhagen, Denmark. The office of the Honorary Secretary, Indian National Committee (Dr. A. C. Ukil), is located at the All-India Institute of Hygiene and Public Health, 110, Chittaranjan Avenue, Calcutta, from whom further information on the subject can be obtained.

For the information of those who will contribute papers, it is stated that a summary not exceeding 200 words should be in the hands of the General Secretary of the Congress at Copenhagen not later than the 1st January, 1947.

UNITED NATIONS RELIEF AND REHABILITATION ADMINISTRATION SOUTHWEST PACIFIC AREA INTERNATIONAL VETERINARY AND LIVESTOCK SECRETARIAT

By A. C. MATHUR

(*Imperial Council of Agricultural Research*)

THE U.N.R.R.A. is made up of 47 member-nations. Each contributing nation provides funds based on its national income for the year ending 30th June, 1943. India is one of the member countries and has contributed relief to the peoples of other lands. It has already made one contribution of Rs. 80 million to U.N.R.R.A.'s work and a second contribution of Rs. 20 million has been voted by the legislative assembly.

The first task of the U.N.R.R.A. is to provide relief; to distribute food, clothes, and medical supplies. In the war-devastated countries, due to the breakdown of the veterinary services and to emergency slaughter of animals for food as well as to the actual destruction of livestock by military operations, the number of the livestock are halved, quartered and in some places almost wiped out. Livestock, as we know, plays a very important role in relief and rehabilitation as it provides food and clothing, power for planting and reaping the crops and aid in maintaining fertility.

To facilitate the provision of such relief in the south-west Pacific area there has been set up an International Veterinary and Livestock Secretariat by U.N.R.R.A. The Governments of the following countries are members of this secretariat. Australia, China, France, India, Netherland East Indies, New Zealand, Philippines, United Kingdom, U.S.S.R., and United Kingdom, U.S.S.R., and United States of America, and in addition the Commander-in-Chief, United States Armed Forces, Pacific, and the Supreme Allied Commander, South-East Asia are also members.

In order to facilitate collaboration among Far-Eastern Governments in connection with international epizootic control and regulations governing such controls, each of the member governments was requested to appoint a veterinarian to confer with representatives of other Governments, at a meeting held at Sydney, Australia, on the 14th to 17th December 1945.

Dr. F. C. Minett, D.SC., M.R.C.V.S., Director, Imperial Veterinary Research Institute, Mukteswar, was appointed representative of the India Government

After each representative at the Conference had described the chief livestock difficulties which confronted their country the conference considered the following 'Notes on Agenda' which had been prepared by a Veterinary Advisory Group composed of eminent veterinary specialists. The notes are as follows:—

1. *Functions of UNRRA SWPA International Veterinary Secretariat*—

(*a*) Exchange between countries of information on Epizootic Diseases:

- (i) Statement on incidence of virus, bacteriological, protozoal, and parasitic diseases in member countries.
- (ii) Exchange by monthly bulletins of information regarding incidence of infectious diseases.
- (iii) Re-establishment of publication of monthly statistical bulletin, based on information supplied by contracting countries as was carried out by the International Bureau of Epizooties in Paris before the war.
- (iv) Transmission by cable or telegram of the occurrence for the first time in the reporting country of scheduled diseases, or of extension of these diseases into areas previously unaffected.
- (v) Nature of common *pro forma* on which the monthly report should be submitted.
- (vi) Exchange between contracting countries explaining the method of veterinary organisation in force, the qualifications and type of training undergone by their veterinary officials, the relative strength of their veterinary personnel as contrasted with their human and animal populations and the methods of control adopted within their territories for controlling infectious diseases.
- (vii) Desirability when transmitting information concerning infectious diseases of inclusion of maps or diagrams showing extent and distribution of particular disease in the reporting country.

(*b*) Acceptable internationally of health certification:

- (i) The purpose of health certification.
- (ii) Schedule of diseases covered by health certification—(*a*) Infectious, (*b*) Other.
- (iii) Nature of certifying authority.

(*c*) Exchange of information on manufacture and marketing of biological products:

- (i) Preparation of a list of biological products manufactured by member countries.
- (ii) Methods of standardisation and control of biological products.
- (iii) Provision for regular interchange of information.

(*d*) International movement and transfer of livestock-quarantine, inoculation, etc.

(*e*) Animal Meat and Animal Products:

- (i) Import and export of meat.
- (ii) Import and export of animal products other than meat.

(*f*) Exchange of administrative, research and other workers and provision of post-graduate educational facilities.

(*g*) Provision for loan of trained technical personnel to countries requiring assistance in an emergency.

(*h*) Possibility of allowing any contracting country to despatch temporary missions or establish permanent veterinary officials in any of the other contracting countries.

2. *Organisation for UNRRA SWPA International Veterinary Secretariat*—

(*a*) Temporary organisation under UNRRA Administration.

(*b*) Permanent organisation under control of United Nations.

3. *Relations of UNRRA SWPA*, etc., with other Regional Groups or countries.

To be sub-secretariat of International Office in Paris.

Following a full discussion the conference adopted twenty-seven Resolutions covering all items on the agenda and incorporating details of information required to be completed, for transmission to the secretariat, by each member country. The Veterinary Secretariat was made responsible for the collection and dissemination to member states, of information in regard to all aspects of the livestock industries of member states, including the incidence and control of diseases and the breeding and feeding of livestock.

The collection and dissemination of information as far as it pertains to India is being undertaken by the Imperial Council of Agricultural Research, and the Veterinary Secretariat in Sydney is disseminating to member countries all useful information which it gets from time to time. Accordingly the Imperial Council of Agricultural Research has received a list of contagious diseases prevalent in the Philippines, Netherland East Indies and New Zealand. A copy of these lists may be had on application to the Secretary, Imperial Council of Agricultural Research, New Pusa, New Delhi.

CENTRAL NATIONAL MUSEUM FOR INDIA

A PLAN for the early establishment of a Central National Museum of Art, Archæology and Anthropology in Delhi, has been completed by the Special Committee appointed by the Government of India for the purpose.

The Committee of which Sir Maurice Gwyer, Vice-Chancellor of the Delhi University, was Chairman, has recommended that the Museum should comprise a Directorate and five Departments, namely, (1) Art, (2) Prehistoric Archæology, (3) Historic Archæology—Buddhist, Jaina, Brahminical, Muslim, (4) Numismatics and Epigraphy and (5) Anthropology—cultural and physical. There will also be a Circulating Department, a Library and a Chemical Laboratory.

The need for such a central institution has been keenly felt in this country since 1912, when the Government of India approached the Secretary of State for the establishment of an Oriental Research Institute in India. This need was repeatedly stressed also in subsequent official reports.

Finally in 1945, the need to establish a Central National Museum was expressed in a Resolution submitted to Government by the Central Advisory Board of Archæology, and was supported by the Standing Committee of the Legislature for Education. The Government of India accepted the recommendation in principle and appointed a Committee of 11 members, under the chairmanship of Sir Maurice Gwyer to frame details. The terms of reference to the Committe included the functions (powers, etc.) of the Museum, general administration, internal organisation, site and building.

The main aim of the Central National Museum is to present to the world the material contribution of India to the sum total of human civilisation. To achieve this the Museum will have to maintain a thorougly representative collection illustrating the arts, crafts and cultures of India down to recent times; and at the same time museum technique and museum service in India will have to be raised to the high international standard.

Committee's Recommendations

The Committee have, therefore, recommended that in the first stage of the scheme a highly trained nucleus staff consisting of a Director and two Keepers may be appointed, and the Keepers be sent on a carefully planned foreign tour which should include a detailed examination of the construction, administration, methods of display, etc., of museums in Great Britain and America.

The function of the Museum will be twofold: to further research and to offer guidance to laymen. The Committee have laid special emphasis on the importance of selecting a suitable Chief Librarian, who will be competent to guide staff and approved research students and scholars in regard to published material in all branches of the Muslim's work.

It has also recommended the appointment of five guide lecturers, one for each section, who will give a series of popular lectures both for schools and for the general public.

The creation of a Circulating Department is another feature of the scheme. The main purpose of this Department (modelled on a similar department in the Victoria and Albert Museum, London) will be to prepare and send out classified loan collections to towns and educational institutions.

On the analogy of other institutions of the kind, the Committee have recommended that the museum should be controlled by a Governing Body including representatives of appropriate Government Departments together with non-officials representing various special interests. The Governing Body should be autonomous, subject only to such conditions as the Government of India may attach to their block grant.

The Museum will be located in Delhi, and the Committee has chosen a site for it. The whole scheme will be worked out in three distinct stages and is estimated to involve, when complete, an annual expenditure of nearly eight and a half lakhs.

NATIONAL STANDARDS FOR INDIA

THE Government of India have decided to set up an organisation called the Indian Standards Institution with headquarters in New Delhi with the object of evolving national standards in respect of structures, commodities, materials and operations, and for promoting standardisation, quality control and simplification in industry and commerce.

The Institution will be managed by a General Council consisting of the Hon'ble Member for Industries and Supplies (President), and 64 representatives from the Central Government Departments, Provinces, States, Research Institutions, Chambers of Commerce and others.

It will be financed by Government and contributions from industry, the Provinces, States and interested public bodies, subscriptions from members and by sale of Indian standards and specifications The Government of India have decided initially to make grants for a period of five years.

The Institution will be divided into five sections, *viz*, engineering, building, chemicals, textiles, and food and agricultural products, each to be controlled by a Divisional Council. The actual preparation of standards will be done by small committees of experts representing various interests such as the producers, consumers and technical experts.

The Institution will be non-official, although supported by the Government of India. The membership will be open to all interested in its objects. Organisations, companies, firms, educational institutions and corporate commercial bodies will be enrolled as Sustaining Members and individuals interested in the work of the Institution as Ordinary Members. The annual subscription has been left to the discretion of the subscriber but to allow even the smallest industry to benefit by the scheme the minimum subscriptions have been fixed at Rs. 250 per annum for Sustaining Members and Rs. 25 per annum for Ordinary Members.

Maintenance of Standards.—The establishment of the Institution is intended to raise the standard of Indian products to he level of other industrial countries. It is recognised that the marketability of any commodity or product depends, firstly upon the intrinsic worth of the commodity and, secondly on the consumer's confidence in the specifications; in other words, on efficiency in production and on the maintenance of standards. One of the chief problems of industries in India is the quality of production.

Again, unless India falls in line with international standards, her export trade will suffer. It is, therefore, of considerable importance to India's peace-time production that her industries, old and new, should be helped to organise on scientific lines and that the standard of Indian products should be raised to the international level. A national standards organisation is thus indispensable to the industrial development of a country.

Vast Industrial Plans.—Due to the diversity of raw materials available in India and the processes employed for manufacture, the British and other standards are not always suitable for adoption in this country.

The proposal to establish a central standards organisation in India for fixing standards was first raised at the Twelfth Industries Conference held in Lucknow in December 1940. Due to the war, however, the Government could not pay much attention to this. With the vast industrial plans that are contemplated in the immediate future, this question has become one of urgent importance. The Government of India accordingly prepared a scheme for establishing a central standards organisation in India which has been generally accepted by all Provincial Governments, Indian States, Chambers of Commerce, and other important industrial organisations.

Objects of Institution.—The objects for which the Institution is being established are *inter alia* to:—

(1) Prepare and promote the general adoption of standards on National and International basis relating to structures, commodities, materials, practices, operations, etc. and from time to time revise, alter and amend the same.

(2) Consider and recommend to Government, national standards for the measurement of length, weight, volume and energy.

(3) Promote standardization, quality control and simplification in industry and commerce.

(4) Adopt such measures and take such steps and do all such things, as may in the opinion of the General Council, be conducive to the promotion of cordial relations between the Institution and persons interested in he objects of the Institution.

(5) Co-ordinate the efforts of produters and users for the improvement of materials, products, appliances, processes and methods.

(6) Provide for the registration of standardization marks applicable to the products, commodities, etc., for which it issues standards, to be branded on or applied to those products, commodities, etc., which conform to the standards set.

(7) Provide or arrange facilities for the examination and testing of commodities, processes, and practices and for any investigation or research that may be necessary.

(8) Procure the recognition of the Institution in any foreign country or place.

(9) Collect and circulate statistics and other information relating to standardizaion in all its branches.

(10) Establish and maintain libraries, museums and laboratories for the purpose of furthering the practice of standardization.

It has been decided that the Institution should be registered under the Registration of Societies Act. A meeting of the General Council will be convened early to consider the terms of the Memorandum of Association and Rules and Regulations.

A DWARF MUTANT IN *NEGLECTUM VERUM* COTTON

BY T. R. KHADILKAR
(*Cotton Breeder, Jalgaon*)

IN the year 1941 a dwarf plant with very small leaves and flowers was noticed by the writer in a large population of cotton plants belonging to the neglectum group and growing in the breeding area of the Jalgaon Farm. Its botanical characteristics and the genetic nature of dwarfness when studied gave the following information.

TABLE I

Characters of the mutant and normal plants

S. No.	Character	Mutant	Normal	Remarks
1	Plant height	30* cm.	100 cm.	The mutant plant presented a very distinct appearance in the field (Plate I).
2	Leaf length	6·5 ,,	12 ,,	
3	Length of middle lobe of leaf	5·0 ,,	10 ,,	
4	Breadth of middle lobe of leaf	1·1 ,,	2·1 ,,	
5	Margin of leaf	Wavy with stray projections	Smooth	
6	Presence of sinus lobes in a leaf	Present	Present	
7	Length of petal	3·4 cm.	4·7 cm.	
8	Breadth of Petal	2·1 ,,	3·7 ,,	
9	Petal colour	Deep yellow	Deep yellow	
10	Length of bract	2·4 cm.	2·9 cm.	
11	Breadth of bract	1·5 ,,	2·4 ,,	
12	No. of teeth in the bract	7	7	
13	Androeceum	Sparsely developed.	Normal	
14	Gynæceum	Stigma elongated, ovules sterile.	Stigma normal, ovules normal.	

* Figures in the table are the averages of six measurements in each case.

The above table shows that the various plant parts of the mutant are about half of the normal in size in most cases except the height which is about one-third of the normal. The number of teeth of the bract is, however, the same in both. The andrœceum and gynæceum show normal development in the dwarf. The few flowers that were found on the mutant did not set fruit either when selfed or crossed with a normal plant indicating its female sterility. When used as a male parent, however, for crossing with a normal plant it produced normal fruits and seeds.

The plant was crossed with two pure strains, *viz.*, N.R. 5 and B. XXI, with a view to study the genetical behaviour of the dwarf habit. Contrasting characteristics of the female parents are given in the table below:—

TABLE II

Parent	Petal colour	Habit of growth	Sinus lobe
N.R. 5	White (yy)	Normal (DD)	Present (ss)
B XXI	Pale yellow (yy)	Normal (DD)	Absent (SS)

TABLE III

Behaviour of F_1 and F_2 of the cross N.R. 5 × dwarf

F_1	Petal colour = Deep yellow		Habit of growth = Fully normal		
Classes in F_2	Yellow petal		White petal		Total
	Normal growth	Dwarf growth	Normal growth	Dwarf growth	
Frequency in F_2 (observed)	115	31	31	14	191
Frequency in F_2 (expected on 9·3·3:1)	107·4	35·8	35·8	11·9	190·6
Deviation	−7·6	−4·8	−4·8	−2·1	

9 : For 33 : 1 X^2 = 2·19 P between 0·70 and 0·50

TABLE IV

Behaviour of F_1 and F_2 of the cross B. XXI × dwarf

F_1	Sinus lobe = Absent		Habit of growth = Normal		
Classes in F_2	Sinus lobe absent		Sinus lobe present		Total
	Normal growth	Dwarf growth	Normal growth	Dwarf growth	
Frequency in F_2 (Observed)	108	42	35	12	197
Frequency in F_2 (expected on 9:3:3:1)	110·8	36·9	36·9	12·3	196·9
Deviation	−2·8	−5·1	−1·9	−0·3	

For 9 : 3 : 3 : 1 X^2 = 0·88 P between 0·90 and 0·80.

In respect of the above two crosses a good fit for the digenic ratio is observed.

From the results of the F_1 generation it is evident that the dwarf habit behaves as a recessive to the normal in both the crosses. In the cross N.R. 5 × dwarf (Table III) yellow petal of the dwarf is dominant to the white of N.R. 5. The F_2 behaviour of the petal colour and dwarf habit jointly give a 9 : 3 : 3 : 1 ratio indicating that the genes responsible for these characters are situated on different chromosomes.

I = Normal and dwarf plant.

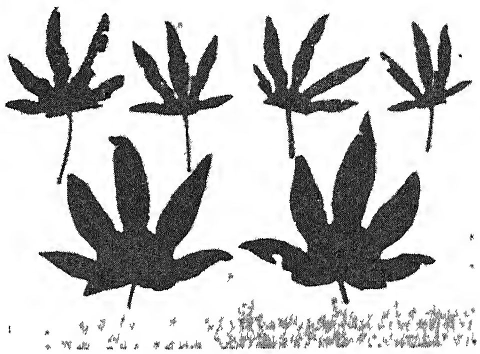
Left : Normal Plant.
Right · Dwarf Plant.

In the cross B. XXI × dwarf (Table IV) the absence of sinus lobes is dominant to its presence or that there is an inhibitor in the B.XXI parent which suppresses the expression of the lobe character in the F_1 generation. In F_2 generation the behaviour of sinus lobe and dwarf habit assort independently on a 9 : 3 : 3 : 1 basis indicating as in the first cross, that the genes controlling these characters lie on different chromosomes.

The genic symbols for the various characters have been assigned as below:—

Yellow petal = YY, White petal = yy.
Absence of Sinus sinus lobe = SS, or II ss. Presence of sinus lobe = ss or ii ss.
Inhibitor = II.
Normal habit of growth = DD.
Dwarf habit of growth = dd.

It may be pointed out that all dwarf plants in the F_2 could be easily distinguished by their dwarf habit of growth, small leaves with wavy margins (Plate II) and small flowers. All such plants were self-sterile and, therefore, could not be grown further.



II = Leaves of dwarf plant with wavy margins. Leaves of normal plant.
Top Row : Leaves of Dwarf Plant.
Bottom Row : Leaves of Normal Plant.

The mutant plant described above resembles in certain respects the crinkled dwarf mutant, observed in barbadense (Sea Island) cotton and also recorded in Egyptian cotton under the name crinkled leaf by Trought and has been found in hirsutum cotton by Hutchinson and Ghose. The points of resemblance in the mutant and the crinkled dwarf are (1) the torn and ragged leaf edges and (2) its simple recessive behaviour in the inter-varietal crosses. The leaf-surface of this mutant is smooth and green as opposed to the crinkled and mosaic leaf-surface of the crinkled dwarf.[1]

I am highly thankful to the Indian Central Cotton Committee for having permitted me to publish this note and to Mr. V. V. Nimbkar for having helped me in taking the various observations in the field.

1. Harland, S. C., *The Genetics of Cotton*, 1939, p. 79.

ATOMIC RESEARCH IN GREAT BRITAIN

A NEW Atomic Energy Research Establishment is being set up at Harwell (Britain). This establishment will be concerned with the development of the scientific and industrial aspect of nuclear energy and with the solution of the scientific problems which will arise in the large-scale production of fissile materials. Physics, Chemistry, Engineering and Biological Laboratories form the main centres of activity in the new establishment. A low-power graphite file is under construction and will be in operation shortly. A high-powered graphite file is also under construction which, when completed, will provide intense sources of radiations and produce, on a large scale, radioactive substances for scientific research and for medical work. For studies in fundamental nuclear physics of importance to atomic energy, an electrostatic generator for the production of 5 million volts and a "92-inch" cyclotron are being built. The Research Establishment is being manned by the large number of British scientists who acquired essential experience in atomic energy development in North America.

The present scientific staff working on the Harwell Project is about 250 of whom 35 are actually working at Harwell.

LETTERS TO THE EDITOR

ON YOUNG'S MODULUS FOR INDIA RUBBER

It is generally made out that the dynamical value of the Young's modulus for India rubber is greater than the statical value E_1.[1] In some cases it is found that E is almost equal to E_1.[2] Various reasons have been put forward for explaining this discrepancy. It is found that Hooke's Law, which does not hold good for large values of the longitudinal stretch, is used for statical values. In experiments conducted with India rubber the stretch is not small, and hence the theory of Finite strain[3] should be used for determining the statical value.

If E′ be the value of the Young's modulus as given by the Finite strain theory, we find

$$E' = \frac{2\,l^2 w}{l^2 - l_1^{\,2}},\; E_1 = W\frac{l_1}{l - l_1} \qquad (1)$$

w being the weight hung and l and l_1 being the stretched and unstretched lengths of the specimen used. Thus

$$\frac{E'}{E_1} = \frac{l}{l_1}\cdot\frac{2l}{l + l_1} \qquad (2)$$

which shows that $E' > E_1$. In fact if $l = {}^3/_2\, l_1$, we get $E' = {}^9/_5\, E_1$, which is practically the dynamical value found in certain cases. Thus the mistake lies in using Hooke's Law.

If w, the weight per unit length of the specimen, is also to be taken into account, we get the result

$$\frac{lw}{E'} = \left(1 - \frac{2w}{E'}\right)^{\frac{1}{2}} - \left[1 - \frac{2}{E'}(l_1 w + W)\right]^{\frac{1}{2}}. \qquad (3)$$

Hindu College,
Delhi, B. R. Seth.

August 14 1946.

1. Deodhar, G. B., and Kothari, D. S., *Ind. Journ. Phys.*, 1928, **2**, 305. 2. Puri, A. N., *Proc. Nat. Acad. Sci.*, 1937, **7**, 45. 3. Seth, B. R., *Phil. Trans. Roy. Soc.*, **1935**, **234**, 231.

WHY LESS OZONE OVER EQUATORIAL LATITUDES[1]

The problem of lower temperature at the tropopause over the equator than in the temperate latitudes has again come into prominence.

In discussing the sounding balloon data of Agra, Ramanathan suggested that the lower temperature at the equatorial tropopause may be due to one of the two causes, the relevant one being strong convective action in the higher layers of the tropopause.[2] The strong convective action can arise if more moisture is present. He found, on an average, more water vapour at all levels of the troposphere in the tropics than in the temperate regions.

Dobson found during the war (1939-45) with the new Hygrometer devised by him that the amount of water vapour about the level of

tropopause and in the stratosphere to be only 1/50 that was expected from previous measurements. In a suggestive paper,[3] he explained the low temperature of the tropical tropopause by considering that the amount of ozone to be less and the amount of water vapour to be more in the tropics than in the temperate latitudes. But he finds no reason why the amount of ozone should be less over the tropics than elsewhere. To import a fresh cause for this decrease may not be necessary. The agencies involved are sun's ultra-violet rays (photochemical action) water vapour and ozone. It is well known that ozone breaks up (slowly, but more rapidly than in the absence of water) in presence of water or water vapour. In many chemical reactions water vapour plays the role of a catalyst.

It is suggested, as a possible solution that the smaller amount of ozone in the tropical air may be due, as a condition of equilibrium, to the excess water vapour itself in presence of ultra-violet light. Similarly in summer in India, when water vapour increases the ozone content may diminish.

Meteorological Office,
Poona, S. L. MALURKAR.
September 24, 1946.

1. Read before the Symposium of National Institute of Sciences, India, Bombay, August 30th, 1946. 2. *Memoirs Ind. Met. Dept.*, 1930, **25**, 183. 3. *P.R.S.*, Feb. 1946.—*Bakerian Lecture for* 1944.

THRESHOLD POTENTIAL, CONDUCTIVITY AND COURSE OF A CHEMICAL CHANGE UNDER ELECTRICAL DISCHARGE

TOWNSEND's theory of ionisation by collision contemplates sensibly the same change on reaching the 'dielectric strength', 'starting', 'break-down' or the spark (Paschen) potential. For elementary gases, this is identifiable with, or is a simple function of the corresponding 'threshold potential' V_m in especially ozoniser type discharges.[1,2,3,4,5] Like Paschen potential, V_m is a sensibly linear function of the gas pressure. As found by the author for V_m,[1,2,5] it is extremely likely that 'electron affinity' of the excited gas, besides its ionisation potential is a chief determinant of the Paschen potential; comparatively, however, V_m would appear to be more sensitive to change of frequency of A.C. supply and of temperature especially in polyatomic gases and reactive mixtures.

The author's general finding[1,2,3,4,5 6] that (*i*) a reaction occurs only above V_m and (*ii*) that at an applied potential V, velocity of the chemical change and the corresponding current i depend principally on V-V_m, has been confirmed by results of numerous discharge reactions studied in these Laboratories, including such quasi-chemical changes under discharge as the activation of nitrogen, its deactivation, 'latent image' formation, etc. (ii) led to the prediction and discovery by the author of a new *light-effect* Δi, an instantaneous and reversible photo-diminution of i observable from X-rays to extreme red in a number of gases and vapours under electrical discharge.[2,5 6]

In part, V_m corresponds to the 'energy of activation' found chiefly from the temperature coefficient, which is a distinctive characteristic of a thermal reaction. It does not enable an experimental separation of a composite chemical change, *e.g.*, into its consecutive reactions. This is possible, however, in a discharge reaction by excitation at V_m. It follows from (*i*) that near V_m the earliest of the (consecutive) reactions would set in with least velocity and minimum decomposition of its products. Excitation at V_m should, therefore, be, a valuable device for isolating (at any rate detecting) unstable, *e.g.*, intermediate products in a discharge reaction. This has been substantiated by results for the decomposition under silent discharge of some oxides of sulphur and nitrogen *per se*, and also in contact with metallic and certain reactive films, studied in these Laboratories.

The marked utility of data for the time-variation of i as a means of elucidating the course of a discharge reaction has been emphasised by the author.[1,2,5] It is about the only criterion of the progress of a reaction (*e.g.*, hydrogen, chlorine combination) unaccompanied by pressure change, without disturbing the system as with a time-to-time analysis of the reaction mixture. This last, gas pressure p, i and such associated characteristics as wattage W dissipated in the system, the spectral nature of the discharge glow, etc., show a greater mutual synchronous variation during the reaction, the nearer to V_m is the corresponding applied V. This, in general, would also favour observation of discontinuities characteristic of the course of the reaction, corresponding to consecutive changes.

Under certain conditions, decomposition of nitrogen dioxide and especially the nitrous oxide + hydrogen reaction under silent discharge, reveal a remarkable periodic effect[6,7] in respect of all variables mentioned above (p, i, W, etc.,); from this and (*ii*), the corresponding V_m should vary periodically; this has been observed. Whilst in general, *Ceteris paribus* excitation near V_m favours the production of this periodic effect, the time-variation of some of the above quantities is affected markedly by but small changes in V-V_m near V_m.

In a Siemens' type discharge tube, the total capacity is determined chiefly by that associated with the annular space which is the seat of both ionisation and the reaction. In a theory[8,9] of the new *light-effect* Δi an assumption is made by the author of an 'electrode layer' derived from the ions and neutral molecules in the discharge space; and that under light *inter alia* a change of phase due to that of the capacity by the photoelectric emission leads to Δi. In the absence of light, an excited layer leading to such a capacitative change may well occur due to the surface activity of especially some of the reaction products If this layer is deformed and in part restored intermittently, the periodic effect, as observed in i and the other associated quantities would follow. Such an electrode layer is anticipated to be stabler the lower the temperature of the system; this is shown by the marked reduction on cooling of the corresponding periodic effect.[6,7]

At V_m a part of the input energy is radiated in space chiefly as high frequency oscillations; their frequencies and the corresponding current ^{i}-aerial increase with V. This applies also to the ordinary circuit conductivity i consisting of $^{i}HF + {}^{i}LF + {}^{i}S$ being due to the frequency of the A.C. supply and its harmonics, ^{i}S would appear to constitute a minor part of i. From the possible capacitance-change during a chemical reaction as in the *light-effect* Δi suggested above, the time-variation of the filtered ^{i}-aerial, ^{i}HF, ^{i}LF, etc., should be synchronous with the stage-wise progress of the corresponding composite change, especially when produced near V_m. Results of periodic reactions now being investigated in these Laboratories are in close accord with this deduction.

Department of Chemistry,
Benares Hindu University, S. S. JOSHI.
October 5, 1946.

1. Joshi, *Trans. Faraday Soc.*, 1929, **25**, 127, 140. 2. —, *Curr. Sci.*, 1939, **8**, 548. 3. —, *Nature*, 1944, **154**, 147. 4. —, *Curr. Sci.*, 1944, **13**, 253. 5. — *Proc. Indian Acad. Sci.*, 1945, **A22**, 389. 6. —, *Presi. Address Chem. Sec.*, *Indian Sci. Cong*, 1943. 7 Joshi, and Deshmukh, *Nature*, 1945, **155**, 483. 8. Joshi, Abst. **26**. *Phys. Sec.*, Indian Sci. Cong., 1946. 9, — *Proc*, *Indian Acad. Sci.*, 1945, **A22**. 225.

ADSORPTION OF HYDROGEN AND CARBON MONOXIDE AND THEIR MIXTURES ON FISCHER-TROPSCH CATALYSTS : PART I

THE adsorption of hydrogen and carbon monoxide has been studied, both from pure gases and their mixtures on a kieselguhr supported catalyst containing 34·2 per cent. cobalt, 4·084 per cent. copper, 2·33 per cent. ThO_2 and 0·2369 per cent. Ce_2O_3 (tried in Fischer-Tropsch synthesis) at temperatures considerably below those where velocity of reaction becomes perceptible It was found that in the adsorption from mixtures, the presence of one gas promoted the adsorption of the other. The increase of adsorption was conspicuous even at 25° C. in the case of hydrogen and became noticeable only at 97° C. in the case of carbon monoxide. Besides, activation was found to set in at a much lower temperature in the case of mixture adsorption than in the case of pure gas adsorption. The relative amounts of the individual gases adsorbed from mixtures increased with rise of temperature even at temperatures above 25° for hydrogen and above 51° for carbon monoxide; in the case of pure gases, this activation effect became appreciable only at much higher temperatures, *viz.*, above 97° C. for hydrogen and 134° C. for carbon monoxide.

The adsorption was measured by a volumetric method. The analyses were carried in a modified micro Bone and Wheeler apparatus. No trace of hydrocarbons was found in the adsorption system at temperatures below 110° C. even after a period of 24 hours which was considered necessary for attainment of adsorption equilibrium.

The enhancement of adsorption of one gas by another cannot be explained on the basis of Langmuir theory, extended to cover mixed adsorption by Markham and Benton.[1] The theory, on the other hand, leads to the conclusion that the adsorption of one gas should decrease the adsorption of the other as was found by Hurst and Rideal[2] in the adsorption

TABLE I.—*Hydrogen*

p	25° C.			51° C.			76° C.			97° C.			107° C.		155° C.
	P.G.	M_1	M_2	P.G.	M_1	M_2	P.G.	M_1	M_2	P.G.	M_1	M_2	M_1	M_2	P.G.
15	—	3·45	—	2·11	3·87	5·18	—	4·79	6·12	2·31	6·69	10·88	9·72	16·25	2·86
25	3·08	4·07	7·00	2·40	4·59	6·90	—	5·68	8·29	2·57	7·27	13·07	11·55	19·80	3·20
35	3·20	3·76	6·94	2·62	5·30	7·16	—	6·66	8·59	2·72	9·19	14·30	15·00	22·71	3·47
60	3·00	—	—	3·09	-	—	—	—	—	3·21	—	—	—	—	4·08

TABLE II.—*Carbon Monoxide*

p	25° C.			51° C.			76° C.			97° C.			107°C.		134°C.	155°C.	178°C.
	P.G.	M_1	M_2	P.G.	M_1	M_2	P.G.	M_1	M	P.G.	M_1	M_2	M_1	M_2	P.G.	P.G.	P.G.
15	9·58	6·50	3·36	7·36	6·43	3·43	7·10	6·95	4·21	7·10	8·34	6·49	10 30	10·39	7·36	9·60	14·78
25	10·93	7·35	3·97	8·44	6·75	—	8·06	7·40	—	8·00	9·00	—	11·86	—	8·18	10·92	17·69
35	11·98	9·85	—	9·44	7·79	—	9·19	8·13	—	8·91	10·75	—	15·10	—	9·25	12·25	20·50
60	14·20	—	—	11·10	—	—	—	—	—	11·15	—	—	—	—	11·91	16·12	26·40

p = partial pressure in cms. of mercury, P. G = volume in c c. N.T P. adsorbed by 9·41 gms. of catalyst from pure gas, M_1 = volume adsorbed from (1 : 1) CO : H_2 mixture and M_2 = volume adsorbed from (1 : 2) CO : H_2 mixture.

of a mixture of carbon monoxide and hydrogen by copper, and by Markham and Benton in the adsorption of a mixture of carbon monoxide and oxygen by silica at 0° C.

It might be mentioned in this connection that Griffin[3] has shown that the presence of a small quantity of carbon monoxide on copper increases the amount of hydrogen adsorbed at low pressures and decreases it at high pressures. Markham and Benton[1] themselves have seen in the adsorption of a mixture of carbon monoxide and carbon dioxide on silica at 100° C. that the amounts of carbon monoxide adsorbed at high partial pressures of carbon dioxide are greater than the amounts adsorbed in its absence and *vice versa*. Further, Lambert and Heaven[4] have found that oxygen and argon mutually increase each other's adsorption on silica gel at 0° C.

Fuller details of the observations reported here will soon be published elsewhere. The investigation is being continued with other gases and catalysts of technical importance.

J. C. Ghosh.
M. V. C. Sastri
K. A. Kini.

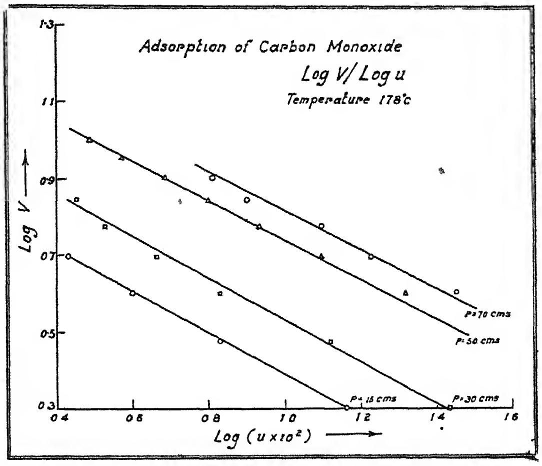
General Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
October 15, 1946.

1. *J. Amer. Chem. Soc.*, 1931, **53**, 497. 2. *J. Chem. Soc.*, 1924, **125**, 685. 3 *J. Amer. Chem. Soc.*, 1927, **49**. 2136. 4. *Proc. Roy. Soc. A.*, 1936, **153**, 584.

ADSORPTION OF HYDROGEN AND CARBON MONOXIDE ON FISCHER-TROPSCH CATALYSTS : PART II.

The rate of adsorption of hydrogen and carbon monoxide was studied on the catalyst containing 34·2 per cent. cobalt, 4·084 per cent copper, 2·33 per cent. ThO_2 and 0·2369 per cent. Ce_2O_3. It was found that the Langmuir equation[1] did not hold. This is to be expected because the Langmuir equation is valid only for adsorption on a uniform shrface. The Bangham and Sever formula,[2] $\log \frac{\sigma}{\sigma - s} = kt^{1/m}$

where σ = saturation value of adsorption s = adsorption at any time t, and k and m are constants, required very high values for σ to give straight lines when $\log\left(\log \frac{\sigma}{\sigma - s}\right)$ was plotted against $\log t$. On the other hand, it was found that the logarithms of the values for the rate of adsorption at constant pressure, when plotted against the logarithms of the corresponding volumes adsorbed, gave straight lines, which for different pressures and a particular temperature were all parallel as could be seen from the graph shown in Fig. 1 for carbon monoxide at 178° C. Similar graphs were obtained at other temperatures and also for hydrogen.



The results of the present investigation suggest the following empirical relationship between the rate of absorption, the pressure and the amount of adsorption,

$$u = k \frac{P}{V^n}$$

where u = rate of adsorption in c.c./min., P = pressure and V = volume adsorbed, n and k are constants.

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October 15, 1946.

1. *J. Amer. Chem. Soc.*, 1918, **40**, 1361. 2. *Phil. Mag.*, 1925. **49**, 935.

INFLUENCE OF CARCINOGENS ON YEAST

Several polyploidogenic organic compounds, *e.g.*, camphor, colchicine, acenaphthene and other related derivatives, have been employed to produce cells with chromosome complements several times higher than the normal. Treatment with camphor, after the first dosage has been found to induce in the cells of *Saccharomyces cerevisiæ*, a strain of brewery yeast. an increase in their volume to about twice that of the normal; a second treatment was found to result in a supergigas race with thrice the volume of the normal.[1]

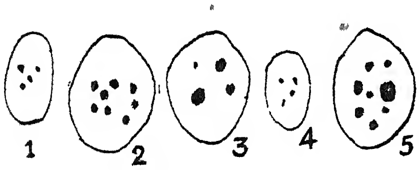
The present work has been undertaken to determine the effect of a few of the available carcinogens, fluorene, fluoranthene, retene and chrysene, on a strain of industrially important distillery yeast (N.C.T.C. 3019). Alcoholic solutions of these compounds (5 mg./ml.) were employed; in the case of the sparingly soluble chrysene, the solution attained saturation since

a portion of the substance remained undissolved. The retene solution was slightly yellowish; that of chrysene exhibited a slight pinkish fluorescence; other solutions were colourless.

The yeast which has a high tolerance of alcohol was plated out on wort agar and the alcoholic solution of the carcinogen (0·5 ml.) was placed in cups equidistantly placed in the plate; one of the petri-dishes received only the pure solvent, absolute alcohol. The method employed was very similar to the familiar "Cup assay" technique now extensively used in the assay of antibiotics.

The colonies developed after five days' incubation at room temperature (23-24° C.) were examined under the microscope for size and cell inclusions. Smears were fixed in carnoy and stained with toluidine blue in accordance with a reproducible schedule standardised in these laboratories. Examination of the permanent slides revealed that retene-treated yeasts showed a significantly high accumulation of nuclear material; this phenomenon was clearly observable, if to a smaller extent, in the case of chrysene-treated cells.

Organisms once treated were respectively subjected to a second dosage of the same chemical, employing the "Cup assay" technique. After five days' incubation at room temperature, the organisms were examined in the same way as described above. The retene-treated cells, to the extent of about 25 per cent. were found to contain, large-sized heavily stained bodies; fluoranthene-treated cells showed a similar effect but to a less pronounced extent. Fluorene-treated cells did not show any effect. Chrysene-treated organisms, on the other hand, attained a large size (twice that of the normal) and became endowed with heavily stainable nuclear bodies; the number and size of these bodies in the cell increased (see Fig. 1). These cells after plating on wort



1. Alcohol. 2. Retene. 3. Fluoranthene.
4. Fluorene. 5. Chrysene.

agar, gave rise to cells which retain the same characteristics as regards cell inclusions. The biochemical performance, that is, the alcohol-producing capacity of these treated strains of yeasts, are now being investigated.

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October 8, 1946.

* Supplied three of the carcinogens employed in these investigations.

1. Bauch, R., *Ber. deutsch. bot. ges.*, 1942, **60**, 42–63.

PITH IN SUGARCANE

THE central core of the stems of dicotyledonous plants, known as 'medulla' or 'pith', is composed of parenchymatous tissue surrounded by a ring of vascular bundles and serves as the place of storage of reserve food materials like starch. Monocots, however, do not contain a well-defined pith since the vascular bundles are not disposed in the form of a ring but are scattered throughout the ground tissue. In sugarcane the term pith is used in a special sense and connotes the chalky white opaque tissue which develops longitudinally in the centre of the stem. It generally consists of parenchymatous cells and sometimes includes a few of the centrally situated vascular bundles also. Depending upon the variety, development of pith commences even when the canes are six or seven months old. The formation of this tissue is followed, after some time, by death and at times disintegration of the constituent cells later on, resulting in the development of a longitudinal hollow. Thus pith formation in sugarcane reduces the storage tissue and consequently the tonnage and yield of sugar. Hence it is a very undesirable character in any cane variety. An attempt was, therefore, made to quantitatively estimate the amount of pith in some sugarcane varieties at the Agricultural Research Station, Anakapalle during 1943-44 and 1944-45, and the results of the latter year are summarised in this short note.

From a ratoon experiment including four varieties (co. 419, co. 421, co. 523 and co. 527) and three treatments (plant crop first ratoon and second ratoon) samples were taken for purposes of this study. Twenty canes, in all, were selected at random from each treatment and variety. This was a composite sample and canes from each subplot were not separately studied. Each cane was cut at the centre of every internode giving a number of cane pieces, each of which had a node at the centre and two halves of interrodes on its either side. The diameters of the top cut end (that half, which had the bud) of each cane bit and that of the pith visible at its surface were measured in two directions. The diameter of the internode and that of the pith was arrived at by averaging the two values (obtained by measuring the diameter in two ways, across and along the bud). The volumes of the different internodes and the pith in the same were calculated by applying the formula $\pi r^2 L$ where L was the length of the top internode. (It was assumed that (1) the internode was cylindrical and (2) the pithy core had a uniform volume throughout any particular internode.) In each case the volume of pith was expressed as a percentage of the volume of the entire cane.

The conclusions from the summarised data presented in the tables, appended separately, are as follows:—

In the varieties under study co. 523 had the highest amount of pith (17·22 per cent. pith to total volume of cane) followed by co. 527 (10·74 per cent.), co. 421 (8·56 per cent.) and co. 419 (3·66 per cent.) in the order of mention. The differences between the percentage volumes of pith in the four varieties were statistically significant. (2) Among treatments,

'second ratoon' recorded the maximum per cent. volume pith and was statistically on par with plant crop. (3) Arrowed canes contained more pith than unarrowed canes in any variety and treatment.

Further investigations to determine the actual loss in tonnage due to formation of pith, when the crop is kept for long on the field, are in progress.

TABLE I

Per cent. Volume of Pith to Total Volume of Cane

Varieties		*Treatments*	
Co. 523	17·22	Second ratoon	10·58
Co. 527	10·74	Plant Crop	10·43
Co. 421	8·56	First ratoon	9·12
Co. 419	3·66		
Critical difference P = 0·05	1·37	Critical difference P = 0·05	1·19

TABLE II

Percentage Volume of Pith in Arrowed and Unarrowed Canes

Variety	Plant crop		First ratoon		Second ratoon	
	Arrowed canes.	Unarrowed canes	Arrowed canes	Unarrowed canes	Arrowed canes	Unarrowed canes
Co. 419	7·45	2·2[illegible]	8·35	1·59	10·51	0·68
Co. 421	12·13	6·73	8·27	6·70	10·31	8·92
Co. 523	22·40	17·32	18·66	13·05	21·09	15·37
Co. 527	11·30	7·08	10·53	10·74	12·81	9·51

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September 23, 1946.

CONCENTRATION OF GRAPHITES BY FROTH FLOTATION

THERE are two types of impurities met with in graphite. One is the inherent ash which is present probably in molecular association with the carbon and is almost impossible to dislodge and concentrate the ore by any device. But the more frequent impurity which brings down the assay value of the sample is the extraneous mineral matter in fine grains which can be removed by physico-chemical methods such as flotation.

Venkateswarlu[1] tried bulk oil flotation on some Indian graphites. Except for this, in the available literature no systematic examination appears to have been carried out on Indian graphites. The Bureau of Mines, U.S.A.,[2] has worked out flotation processes for the concentration of very low grade oxidised and unoxidised graphite ores from Alabama, New York, assaying 5-10 per cent. graphitic carbon. Enrichment to 90 per cent. carbon with 70-80 per cent. recovery has been shown to be possible.

A considerable quantity of unoxidised graphite ore is mined in some localities in West Godavary District and in the contiguous parts of the Nizam's Dominions. The better grades are exported and the inferior ones used for making crude graphite crucibles at Rajahmundry. In one plant some concentration is achieved in water tanks by sedimentation of the impurities. A good part of the graphite mined which assays less than 55 per cent. carbon, is at present being discarded. This loss obviously is preventable.

The general principles of flotation are well understood in the graphite industry but successful commercial exploitation requires a detailed study of the local factors such as particle size. and pH of the natural pulp, conditioning required, the chemical composition of the mineral matter and the method of flotation to be employed.

For this preliminary investigation samples of graphites from the Godavary and Vizagapatam districts have been employed. A single stage froth flotation using pine oil was carried out in an apparatus designed for the purpose and constructed out of material commonly available in the laboratory.

The apparatus consists of a sintered glass funnel, the stem of which is passed through that of a large-sized ordinary funnel and fixed by means of a cork. The outer funnel serves to collect the overflowing froth. Air from a compressor is fed into the sintered funnel through an orifice-meter and constancy of flow is assured by means of a cock in the line. The air is well distributed in the system.

The ground ore (30 gm.) passing through 50-mesh was pulped with water (150 c.c.) and treated with pine oil (0·2 c.c.). The pulp was placed on the sintered bed and aeration started. The frothing was complete in about 12 minutes. The froth and the gangue were separately filtered, dried and weighed. Carbon percentages were determined on the crude as well as the froth and gangue by the wet oxidation method.[3] The results are recorded below:—

District	Sample No.	Carbon %			Recovery %
		crude	froth	gangue	
West Godavary	1	69·1	80·4	42·6	70·1
,,	2	26·4	58·2	18·1	20·7
,,	3	17·6	52·6	12·1	13·6
East Godavary	4	41·3	74·2	28·0	28·8
,,	5	32·1	64·1	26·9	14·0
Vizagapatam	6	14·2	36·3	9·8	16·6

It is clear that in all cases appreciable enrichment occurs even with an unconditioned coarse pulp in a single stage froth flotation in a simple apparatus. The results are encouraging as regards enrichment, but except in one case the recoveries are poor. Further investigation is necessary and is being taken up.

The authors wish to thank Dr. K. Neelakantam for his kind interest in this work.

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September 26, 1946.

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MILK OF HE-GOAT

Recently I have come across an instance of a he-goat giving milk from both the teats since last November. The maximum amount secreted was 6-7 oz, but this has considerably decreased and the output to-date is only ¾ oz. The goat behaves quite normally in other respects and is used for stud.

Two samples of this milk were collected and analysed. The average of these two determinations were: Fat (Gerber) 4·6 per cent.; Total solids (gravimetric) 14·4 per cent.; Solids-not-fat 9·8 per cent. This milk seems to be normal compared to the average figures reported for the milk of she-goat.

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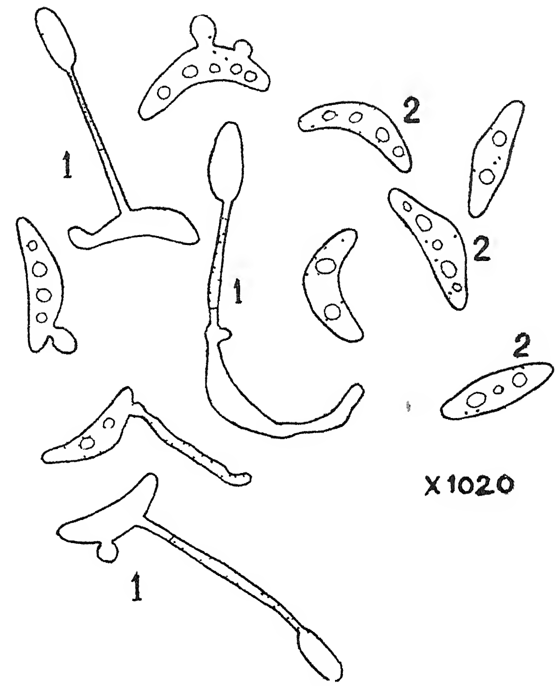
A NOTE ON THE OCCURRENCE OF *SPHACELIA* ON *CENCHRUS CELIARIS*

Occurrence of the genus *Claviceps* in India has been recorded by various workers on different hosts. McRae (1917) described *S. sorghi* on *sorghum* in Madras Province. Ajrekar (1926) has recorded the same fungus and also Sphacelia on *Dichanthum nodosum*, *Dichanthium annulatum*, *Pennisetum Hohenœkeri* and *Ischœmum pilosum* in Bombay Province. Ramakrishnan (1937) has recorded Sphacelia on *Panicum ramosum* from Coimbatore. Thirumalachar (1943) has observed a *Claviceps* on sugarcane in Mysore and Sphacelia on *Digitaria longifolia*, *Symbopogon cœsium* and *Heteropogon contortus* in 1945. Thomas and others (1945) have published a list of grasses on which occurrence of Sphacelia has been observed by them. This list comprises twenty-one grasses of common occurrence in South India.

At Coimbatore a Sphacelia has been observed by the writer, to occur on *Cenchrus celiaris*, a common fodder grass of South India. The grass has not been included in the list of hosts of the fungus so far published. The description of the fungus is given below:

Conidia are formed in light yellowish drops of viscous 'honey dew', which later on dry up into an yellow gummy mass. Conidia are hyaline, falcate or sickle-shaped with more or less pointed ends, one-celled with 2 to 6 conspicuous vacuoles and measuring $18{\cdot}37 \times 5{\cdot}96\ \mu$, the



1. Germinating conidia with the germ tube and the secondary conidia at the tip.
2. Conidia.

Sphacelia on *Cenhus celians*
Left-Single Flower. Right Affected panicle

range being 14·0–25·2 × 5·0–8·4 µ. The conidia readily germinate in water producing an oval secondary conidia at the tip of the germ tube.

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September 20, 1946.

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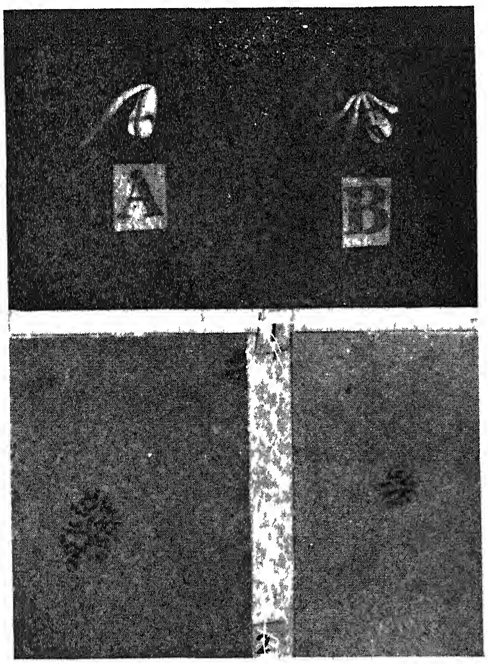
HAPLOID-HAPLOID POLYEMBRYONY IN *SESBANIA ACULEATA* PERS.

WHILE germinating the seeds of *Sesbania aculeata* Pers. for chromosome studies, the author observed one seed with two radicles. Dissection of this seed showed the presence of two seedlings (Fig. 1 B). One of the



FIGS. 1–3. *Sesbania aculeata* Pers. Fig. 1. A, a normal seedling, B, twin seedlings. Fig. 2. Root tip of normal seedling, showing 24 somatic chromosomes. Fig. 3. Root tip of one of the twin seedlings showing 12 chromosomes.

twin seedlings was bigger and from its size resembled a normal seedling. The other was comparatively smaller in the size of its cotyledons, but possessed a normal radicle and plumule. The dissection further showed that it was a case of multiple seedlings of the conjoined type as no direct morphological attachment existed between the twins.

To investigate the nature of each of the twins, root-tip sections were obtained. For the sake of comparison, sections were also obtained from normal root tips. The root-tips from normal seedlings showed 24 chromosomes (Fig. 2), while the chromosome number in root-tips of both the members of the polyembryonous seed was 12 only (Fig. 3). This clearly shows that it is a case of haploid-haploid polyembryony. Ordinarily whenever there are two embryos in one seed, one embryo shows the normal diploid member. The other may be either haploid, triploid or tetraploid. The haploid-haploid polyembryony is of very rare occurrence and only a few cases have been reported such as *Asparagus officinalis* L. (Randel and Rick, 1945) and *Gossypium barbadense* (Webber, 1940).

Nothing can be said with certainty about the origin of this case of haploid-haploid polyembryony. Ramiah, Parthasarathy and Ramanujam (1933) from their study of haploid-diploid twins in *Oryza sativa* believed that the haploid embryo originated parthenogenetically from a synergid or an antipodal. Later on (1935) they suggested that formation of more than one embryo-sac within a single ovule of *O. sativa* may result in the origin of polyembryony Harland (1936) with regard to *Gossypium barbadense* and *G. hirsutum* says that polyembryony here involves the production of extra embryo-sacs. Cooper (1943) suggests that many of the haploid plants seen to-day have originated from embryos arising from synergids. It is quite possible in this case, that both the haploid embryos have originated from the same embryo-sac parthenogenetically from two of the cells of the embryo-sac.

This case of poly-embryony in *S. aculeata* Pers. helps to explain the discrepancy between the different chromosome numbers reported for this species by the present author (1946) and Rao (1946). According to present author the chromosome number for this species is $2n = 24$ and $n = 12$, while Rao reports $2n = 12$. It is very probable that the plants studied by Mr. Rao were haploid.

I am thankful to Dr. A. C. Joshi for his kind criticism and to the late Dr. V. K. Badami for guidance during the investigation.

College of Agriculture,
Benares Hindu University, A. HAQUE.
September 10, 1946.

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A NOTE ON THE OCCURRENCE OF *PTEROSAURIA* IN INDIA

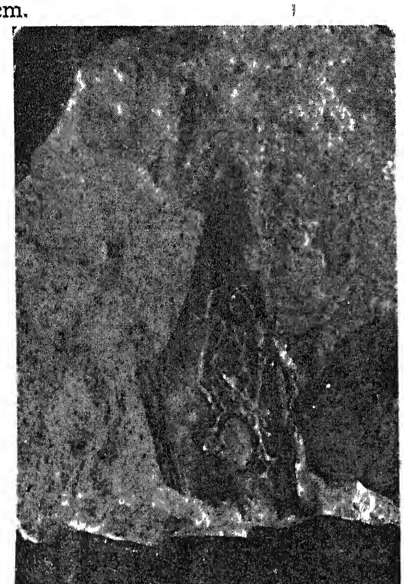
WHILE working in the eastern part of the Kotah State in January 1944, near the village Sirolkhal, a boulder was found which, on breaking yielded a very nice fossil jaw of a reptile.

After a detailed study as far as is possible in this country, it has been provisionally assigned to the order pterossauria, commonly known as the flying reptiles. The specimen is now being sent to the British Museum for a detailed generic and specific identification. The works of Lydekkar, Mately and L Rama Rao have revealed the general presence of the reptiles of the orders of Dinosauris and Ichthiosaurs.

The boulder occurs in a formation which overlies the Vindhyans and which in its turn is overlain by the Trap flows. The rocks are highly arenaceous and silicified shales, deposited under the laccustrine conditions. In the field this is infra rap in position. But, however, owing to the abundance of Physaprinsepii; a conspicuous genera of inter-trappeans, the possibility of its being of inter-trappean age too cannot be ruled out.

Description.—The length of the jaw is 7·4 cms. After 2·4, cms., there is a notch from where it is projected onwards in a beak-like form. There are five sockets in the jaw, three of which contain teeth, and two are marked by the impressions only. Out of these three, one is fully preserved and the other two are not in a good order of preservation. As the teeth are not well preserved, hence it is very difficult to suggest as to whether the size of the teeth were in a decreasing or increasing order, and to which portion of the jaw the specimen belongs. The sockets are quite close to each other, and the teeth are placed at the margin of the jaw. The teeth are slender, conical and blunt at the apex. The closeness of the sockets suggest that animal must be having a large number of the teeth.

Measurement of the Jaw:—(1) Measurement of the jaw—7·4 cms.; (2) Length of the gum at the anterior end after 2·4 cms.—·3 cm.; (3) Breadth of the jaw at the posterior end—1·4 cm.



Measurement of the Gum:—(4) Breadth of the gum—1·4 cm.; (5) Length of the gum in the specimen containing three teeth—4 cms.; (6) Breadth of the gum at the distal end—1·6 cms.; (7) Height of the tooth—1·6 cms.; (8) Crown of the tooth—·6 cm.

Measurement of the Sockets at the base of the Crown:—(9) Major axis—·5 cm.; (10) Minor axis—·3 cm.

The nature of the teeth as described above resembles closely with the teeth of the flying reptiles or Pterosauria, the teeth of this animal when present are slender, conical and placed at the apex. They are insectivore, that is, live upon the animals.
(Zitel v.part II p.o.)

Discussion.—The blunt apex and other features suggest that the animal must not have been carnivore or herbivore, but was as insectivore. As usually found that in the case of the former, *i.e.*, in carnivores they are sharp and pointed, while in the case of the latter they are complex.

This group of the reptile is reported from a number of places in Europe, Africa and North America from rocks ranging in age from lower Jurrasic to Upper Cretaceous. The Pterossauria which appeared in Lower Jurassic reached to its climax during the Upper Cretaceous, and have also been reported from Brazil and Africa. As it is assumed that the land connection during the Upper Cretaceous existed between these countries and India, hence there is every possibility of their migration and existence over here. Prof. Von Huene who had made a study of the dinosaurian remains of India also remarked, "The dinosaur of India are closely allied to those occurring in the cretaceous of Madagascar and also with those of Patogonia and Brazil". This may also be taken as a support to the migration of Pterossauria in India.

Conclusion.—From the nature of the teeth and the association of the rocks, *i.e.*, the remains of the Pterossauria are usually met with in estuarine and marine rocks and sometimes in the lacustrine too, we are thus inclined to assign it provisionally to the order *Pterosauria.*

Acknowledgment.—We are thankful to Dr. Raj Nath, Head of the Department of Geology, Benares Hindu University, for his keen interest in the work, and to Mr. I. P. Thapliyal, for his helpful discussions.

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October 8, 1946.

REFRACTIVE INDEX AND REFRACTIVE CONSTANT OF MILK LOW IN SOLIDS-NOT-FAT

The method of estimation and the limits of the refractive index and refractive constant, K, of milk were indicated in an earlier note.[1] Elsdon and Stubbs[2] pointed out that the refractive index of milk-serum fails as an infallible criterion of the purity of milk because the constant varies more or less with the solids-not-fat (S.N.F.) content of milk; and samples with low S.N.F. have usually an R.I. below the normal. This fact has the disadvantage of giving the benefit of doubt to all samples with low R.I., although the value might have been lowered artificially.

A similar relationship between the R.I. of milk and the S.N.F. also holds good, after a fashion, as shown in the following table and the accompanying figure which includes samples with S.N.F. below 8·5 per cent.

Relationship between certain constants of milk low in S.N.F.

Density (20°C.)	S. N. F. %	R. I (40°C.)	K
	Cow Milk		
1·0272	8·38	1·3457	0·2070
47	7·97	50	72
48	8·14	50	72
73	8·22	49	67
55	8·23	54	72
69	8·30	50	68
73	8·28	55	70
81	8·30	50	65
15	7·36	43	75
50	8·29	51	72
80	8·43	56	68
62	8·32	57	72
55	8·04	54	73
73	8·28	53	69
	Buffalo Milk		
60	8·31	65	78
85	8·04	78	82
44	8·13	63	80
40	8·19	67	83

Fig. 1 illustrates clearly the fact that gross differences in S.N.F. are reflected in R.I. also.

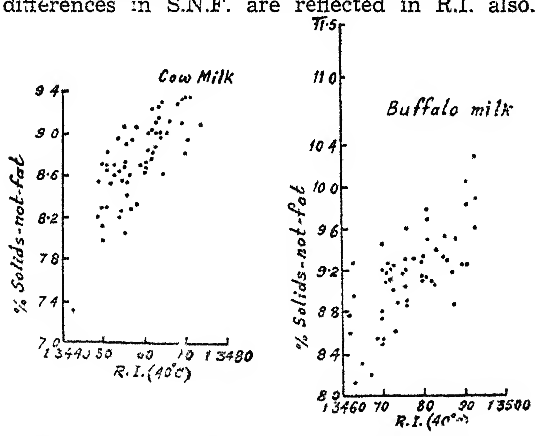

FIG. 1. Relationship between Solids-not-fat and Refractive Index of Milk.

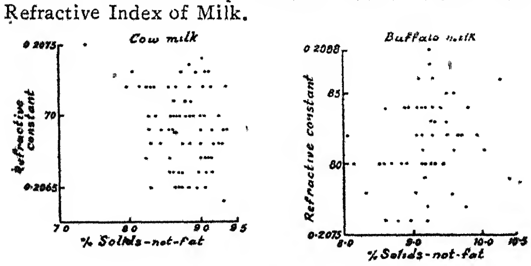

FIG 2. Relationship between Solids-not-fat and K in Cow and Buffalo milk.

The refractive constant, however, is free from this disadvantage. As can be seen in Fig. 2 and the table, K bears no relationship to the S.N.F. constant of milk. For all values of S.N.F. of genuine milk, K lies between 0·2065 and 0·2075 for cow milk, and between 0·2076 and 0·2088 for buffalo milk. A noteworthy feature is that samples with low S.N.F. are found to be usually associated with low R.I. and values of K considerably above the minimum for normal milk. It may be possible that this is a feature, more or less, characteristic of samples abnormally low in S.N.F. On the other hand, attempts to lower the S.N.F. by addition of water only succeed in bringing down the values of both R.I. and K, which must, therefore, be viewed always in conjunction with each other. Added water thus begins to reveal itself at levels of about 10 per cent. addition.

The complete paper on the subject will be published elsewhere.

My thanks are due to Mr. B. N. Banerjee and Prof. V. Subrahmanyan for their kind interest in these studies.

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Bangalore,
October 7, 1946.

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EFFECTS OF PENICILLIN ON BONE PHOSPHATASE

SILVER AND GOLDING[1] have reported that sulphonamide drugs which are commonly introduced in high concentrations at the site of fracture inhibit bone phosphatase. There is accumulating evidence[2,3] that the phosphatase of bone plays an essential role in normal bone formation and probably also in bone repair. We decided to study the action of penicillin on bone phosphatase as this drug is extensively used either alone or in combination with sulphonamides in fractures and other bone diseases. Observations were made *in vitro*.

CHEMICAL METHODS

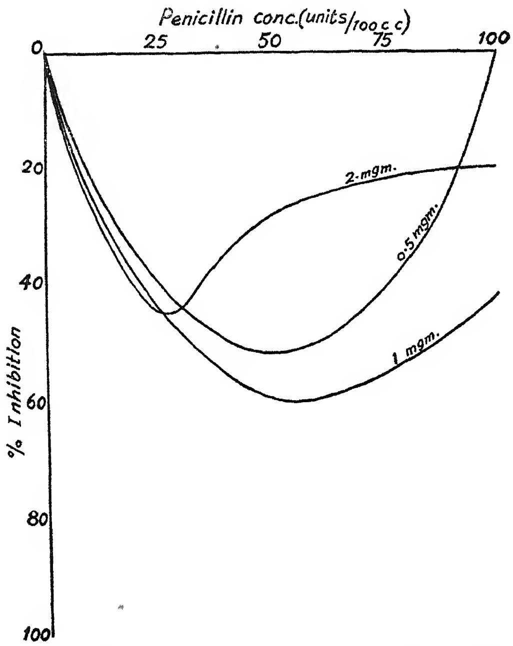
The bone phosphatase was prepared from young growing rabbit's bone by the method of Mortland and Robinson.[4] Phosphatase activity was determined by the method of Binkley, Shank and Hoagland.[5] It consists of incubating disodium phenyl phosphate and veronal buffer at pH 9·2 with phosphatase. Phenol which is split off, is determined colorimetrically by the blue colour given with the Folin-Ciocalteu reagent using the Klett-Sommerson photoelectric colorimeter. Tyrosine was used as a convenient standard and the phosphatase activity expressed in tyrosine units. Penicillin was added to produce concentrations comparable to those that might be present in wounds instilled with this drug. The concentrations of penicillin used were from 25 units per 100 c.c. to 100 units per 100 c.c.

The phosphatase concentrations employed in the reaction mixture were from ½ mg. per 10 c.c. to 2 mg. per 10 c.c. It was also found that commercial samples of penicillin gave a

blue colour with Folin-Ciocalteu reagent and had no action on the substrate alone. Although penicillin did not have the maximum stability at pH 9·2, it retained 70 to 80 per cent. of its potency for a period of 10 hours[6], at that pH.

RESULTS OF *in vitro* EXPERIMENTS

The results are illustrated graphically in Fig. 1.



1. *Enzyme ½ mg. per* 10 c.c.—The concentrations of penicillin employed were 25, 50 and 100 units per 100 c.c. The maximum inhibition of the enzyme was caused by a concentration of 50 units per 100 c.c. of penicillin. The inhibiting action rapidly increased at first so that with 25 units per 100 c.c. the inhibition was 39·5 per cent., with 50 units per 100 c.c. It was 51·96 per cent. and then there was a sudden decrease and no inhibiting action was produced with the penicillin concentration of 100 units per 100 c.c.

2. *Enzyme* 1 *mg. per* 10 c.c.—Here also the inhibiting action rapidly increased so that with 25 units per 100 c.c. the inhibition was 43·38 per cent., with 50 units per 100 c.c. it was 59·82 per cent. and then there was a gradual decrease of inhibiting action.

3. *Enzyme* 2 *mg. per* 10 c.c.—There was a peculiarity in the behaviour of the enzyme. The inhibiting action rapidly increased at first, so that with 25 units per 100 c.c. the inhibition was 44·12 per cent., with 50 units per 100 c.c. the inhibition was 27·96 per cent. and with 100 units per 100 c.c. it was 20·54 per cent.

The results show that penicillin in the maximal concentrations that can be produced in the tissues does not significantly inhibit bone phosphatase. On the other hand, a marked inhibiting action is noticed with lower concentrations of penicillin. The peculiarity exhibited by higher concentrations of the enzyme on penicillin could be explained by the protective action exerted by the enzyme at those concentrations.

Pharmacology Section, S. NATARAJAN.
Indian Institute of Science, N. N. DE.
Bangalore,
October 16, 1946

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LOSS OF NITROGEN FROM SEWAGE

THE major part of the nitrogen present in food materials ultimately finds its way into sewage. The daily discharge of sewage from the major cities of India, with an aggregate population of about 45 millions, may be estimated to be about 450 million gallons and this would contain roughly 90 tons of nitrogen in combination. This, in turn, would be equivalent to 425 tons of ammonium sulphate per day or 1,54,760 tons per annum. If similar discharges from the smaller towns and major villages are included, the total equivalent of nitrogen would be considerably more. The aggregate amount of nitrogen would thus be considerably more than the amount of the synthetic fertiliser proposed to be manufactured in the country.

In our earlier communications,[1–3] we have drawn attention to the loss of nitrogen from Indian soils. Even nitrogen fixed from the atmosphere is not stable and is steadily lost.[4,5] We have observed that nitrogen of sewage is also rapidly lost. The loss occurs under all conditions—aerobic, semi-aerobic and anaerobic—though the extent of loss is variable and seems to be at a minimum under controlled aerobic conditions. It takes place in treatment tanks, during land irrigation and during sewage farming. During intensive aeration, there is an initial conservation as observed by Fowler and associates[6] but when the aeration is prolonged, there is steady loss of total nitrogen (over 75 per cent.). Under anaerobic conditions, represented by the septic tank, a very large part of the nitrogen occurs as free and saline ammonia and this is rapidly lost on exposure to air. Similar changes occur during land filtration, the sewage being largely septicised before reaching the beds. There is also heavy loss of nitrogen during sewage farming. The soil accumulates very little nitrogen even after several years of farming. The loss is quite heavy, even allowing for the removal of nitrogen in the form of crops. The following results illustrate the position in regard to three farms (Table I).

TABLE I

Nitrogen contents of soils under sewage for varying periods

	Calculated quantity of sewage nitrogen (N) applied to soil per acre in lbs.	Calculated quantity of nitrogen removed by grass in lbs.	Nitrogen retained in the soil as determined by analysis (in mgm. per 100 gm. of air dry soil, taken from 0–9″)	Quantity of nitrogen retained in the soil per acre as calculated from the analytical* figures in lbs.	Calculated loss of nitrogen per acre in lbs. rounded		The loss of nitrogen from sewage in terms of ammonium sulphate per acre in lbs. rounded	
					During the whole period	Per annum	During the whole period	Per annum
Madura Sewage Farm								
(*a*) Virgin soil from the area adjoining the Madura Sewage Farm	Nil	Nil	47·8	..	..	..	..	..
(*b*) Under sewage for 18 years	64,800	18,000	97·2	894	46,000	2 600	2 16,000	12,000
Bangalore Sewage Farm								
(*a*) Virgin soil from the area adjoining the Govt. Sewage Farm	Nil	Nil	24·4	..	..	..	..	..
(*b*) Under sewage for about 25 years	90,000	25,000	58·2	676	64 000	2,600	3,03,000	12,000
Experimental Plots at the Institute								
(*a*) Virgin soil from the area adjoining the Sewag Fearm	Nil	Nil	87·9	..	..	..	..	..
(*b*) Under sewage for 2½ years	9,000	2,500	107·1	384	6.000	2,400	29,000	12,000

* Taking one acre as being equivalent to 2 million pounds of soil.

The figures given in the above table, excepting the analytical data, represent approximate calculations. The farms referred to receive a minimum of 15,000 gallons of sewage per acre per day. This would correspond to 3,600 lbs. of nitrogen per acre per annum. Allowing for a maximum cropping of 120 tons of grass per annum (which has not been possible under the conditions at Bangalore), the nitrogen thus removed would correspond to 1,000 lbs. The total nitrogen removed in drainage would approximate to 500 lbs. The major part of the remaining nitrogen is lost.

The loss goes on with continued day-to-day application to soil. Even in the absence of drainage and crops, there is steady loss as may be seen from repeated application at four-day intervals. The added nitrogen should have contributed 32 mgm. per 100 gm. of soil at the end of 24 days, but actually it was found to be only 5 mgm. per 100 gm. There was a tendency for the nitrogen level to remain stationary after the first fortnight, thereby showing that, under normal conditions, the rate of destruction tends to increase.

We have found that the major part of the nitrogen is lost in the form of ammonia. This occurs most rapidly when septicised sewage is spread over the soil on a warm day. If this loss could be prevented or, at any rate, the nitrogen made fully available to the immediate crop, there will be greater return in the form of plant food.

If the ammonia could be neutralised in some simple and automatic manner, there will naturally be less rapid loss from the soil. An alternative would be to ensure the presence of a dense vegetation that will continuously utilise the nitrogen of the sewage. Fodder and forage crops, as also leafy vegetables, respond best to sewage, but even these could not utilise all the nitrogen. There will be greater economy—without sacrifice of yield—if the same crops could receive diluted sewage. At least double the area could also be brought under sewage farming and the loss of nitrogen could be considerably reduced. If all the three steps, *viz.*, neutralisation of ammonia, dilution and a dense leaf crop could be combined, the loss could then be further reduced.

If the sewage is to be subjected to any pretreatment, then the most efficient system would be to intensely aerate and then to remove the sludge. The sludge would conserve the maximum amount of nitrogen and if it can be dried without reverting, then nitrogen loss will be at a minimum. The effluent will then contain only a small fraction of the total nitrogen. In this respect, the Activated Sludge Process is the most attractive among those so far devised.

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September 18, 1946.

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REVIEWS

Notes on Microscopical Technique for Zoologists. By C. F. A. Pantin. (Cambridge University Press), 1946. Pp. viii + 1-73. 6*Sh.* net.

There are many books available for guidance in microscopical technique but most of these, while exceedingly helpful to the experienced student, are often confusing to the beginner. A large variety of techniques is often described without judicious emphasis on whether a procedure is best suited for routine or for research on specific problems. This was largely the result of the high standard of scholarship maintained in the first and subsequent editions of Bolles Lee's *Microtomist's Vade Mecum* which was the precursor of many similar publications. The present book gives an account of methods found most satisfactory at the Zoological Laboratory, Cambridge, during the course of routine instruction and research.

The book is divided into a section describing the general methods of observation for living objects, fixation, sectioning, staining and reconstruction and another devoted to special methods for the demonstration of nerve cells. cytoplasmic inclusions and other specific constituents. This is followed by an appendix giving methods of preparation of saline media and cultivation of organisms. A very commendable feature is the emphasis given throughout these notes to the Chemical and Physiological principles on which the different methods are based. Most of these have been brought up-to-date and the improvements in microscopical technique effected by British workers in recent times have been incorporated. The descriptions given are brief and lucid. In a work of this kind one is bound to feel that something or other might have been added with advantage to those already included but this is no fault of the author who was confronted with choosing a few successful methods from a large number for the special benefit of students and those starting research in Zoology.

Pantin's book deserves a place in every laboratory bench where its frequent use as a guide for microscopical work seems assured.

N. K. Panikkar.

THE B.D.H. Book of Organic Reagents. (Ninth and Enlarged Edition.) (The British Drug House, Ltd., Graham Street, London N-1.) Pp. 196. Price 4/6.

With the development of the utilization of micro-methods in analytical chemistry, recent years have witnessed the use of innumerable organic reagents which are becoming increasingly important in delicate analytical practice. In the book under review, which is the ninth and enlarged edition of the Book of Reagents, published in 1932, directions for the use of 71 of the important organic reagents are given. Adequate descriptive matter relating to spot tests as applied to micro-analysis, clear working details for many colorimetric determinations, a number of methods of analysis in which organic reagents are used, new and improved directions for the use of many of the organic reagents utilized in analytical practice, comprehensive and up-to-date bibliography to include relevant methods in published literature appended for each reagent and finally alphabetically listed index of compounds are the salient features of this useful book.

Organic reagents such as dihydroxy-tartaric acid osazone included as a reagent for the detection of calcium in the previous edition, has been omitted since experience has shown that it had but limited value over more orthodox methods. Phenyl-thiohydantoic acid used for the determination of cobalt, phenylamino-benzene-azo-benzene sulphonic acid employed for the colorimetric determination of magnesium, have been omitted for similar reasons. Four additional organic reagents, *viz.*, tri-keto-hydridine hydrate for the determination of free amino acids, 8-hydroxyquinaldine useful for the gravimetric determination of zinc, benzyl-iso-thiourea hydrochloride for the characterization of sulphonic acids, *p*-nitro-benzene-azo-orcinol for the evaluation of minute quantities of beryllium in alloys are included.

The book has been skilfully compiled; not merely rearranging the matter previously published, but significant changes in the methods previously published, new and improved directions to include up-to-date procedures in analytical practice have been incorporated. This book can be unreservedly recommended to chemists and workers associated in conducting delicate chemical analysis.

M. S. Muthana.

Snow Balls of Garhwal. (The Universal Publishers Limited, Lucknow), 1946. Pp. 87. Price Rs. 3-12-0.

Notwithstanding the uninterrupted march of modern science and concomitant economic and cultural progress the effects of which are strikingly and prominently visible in the different strata of societies influenced and moulded by such progress, there exist even to-day specifically patterned tribes and sections of humanity living in hills and jungles their own curious lives untouched by the forces that constitute the so-called modern civilization scientific and systematic study of which is bound to throw considerable light on the evolution of mankind in general and the penetration of civilization in particular to the nooks and corners of social organizations. Thus, from the standpoint of Sociology and Anthropology, the studies brought together in the volume under notice are bound to be of immense interest to all students of mankind. The volume under notice stands in TWO parts. The FIRST part opens with a discussion and constructive elucidation of the basic and essential characteristics of the different tribes by D. N. Majumdar, who, writing under the heading "*Malaise* of Culture", points out that there are "over THIRTY-MILLION

primitive tribes in India and about FIFTY-MILLION 'scheduled', 'depressed', etc., classes, and emphasizes the need for a thoroughgoing study of the habits of life and culture of these tribes". "Indian Folk-Lore" is the subject-matter of a learned contribution from Sir Sita Ram. He has brought together certain typical songs sung by the village-folk in connection with celebration of marriages, child-births, etc. In the next contribution "Santal Marriage Songs" have been done into English by W. G. Archer. In the fourth contribution, "The Folk-Songs of Dangi Bhils" in choice collection, are brought together and explained by D. P. Khanapurkar. In the SECOND part entitled "Snow Balls of Garhwal", Dr. N. S. Bhandari presents about sixty Folk-songs collected by him during an ethnographic tour undertaken in connection with collection of data for his Doctorate Thesis, the tour covering the interior of Garhwal. The volume contains a number of attractive Lino-Cuts by L. M. Sen.

From the foresketched summary of the main contribution made by the volume under notice which forms a member of the "Folk-Lore Series", edited by D. N. Majumdar, it should be admitted that the life led by the members of the so-called civilized sections of a nation or a country can hardly be taken as affording a full and complete picture or portraiture of the social organization as a whole. A scientific, objective study of the manners and customs of these primitive tribes is one thing, while a concerted attempt at taking the benefits of modern civilization to the very doors of these primitive tribes is totally another. D. N. Majumdar complains, "Wherever missionary influence has been long and durable Christian ideas have disintegrated tribal life and destroyed tribal values". That cannot be helped. If as the result of the advancement of modern science and scientific inventions, civil aviation becomes as it now has, a matter of daily routine means of communication, there is absolutely no use or good in pathetically clinging to the bullock-cart mentality, though, of course, it would be perfectly legitimate and amusing to exhibit the bullock-cart on postage-stamps in grateful remembrance of its past help and services. When a new ideology and a new practical methodology based on it assail primitive tribes as they must in any attempt at making or helping them share the benefits of civilization, a disruption of their old patterns of life and individual and communal behaviourism must be deemed inevitable. It would be withal unethical and immoral to seek to perpetuate the tribal patterns simply as sociological and anthropological museum-specimens, for purposes of comparative research and investigation. If, as the result of infiltration of new ideas, tribal methods of life as in the case of the Chota-Nagpur labour-women change for the worse as it must seem on account of free sex-relations and so forth, there would be no good shedding tears over the disruption and disappearance of tribal patterns and values.

Two significant lines of reform can safely be indicated. From the folk-song given on p. x, relating to the incestuous relation between an aged father and a lusty and attractive daughter, it is evident that many tribes need to be taught elementary principles of morality as illustrated in monogamy, eradication of incestuous unions, etc., and such a reformation can well be brought about on the basis and foundation of a nucleus supplied by the tribal culture itself. By this method, both ends may easily be achieved—preservation of the essentials of the tribal culture and radical rehabilitation or reconstruction of the tribal moral outlook. (2) The second would be the reclamation or humanization of the criminal tribes which seem to number in the neighbourhood of two million souls and over. The State and the humanitarian organizations must take courage in both hands and endeavour in a concerted and persistent manner to wean these millions from criminal and anti-social patterns of behaviour. With your permission, I shall extract some few lines from a touching message from a wife to an absentee husband, which is strongly and powerfully reminiscent of Kalidasa's celebrated *Meghadoota* :—

> Hark, hark, you morning breeze,
> Tell my lord I waited him come
> . ...
> A flash of lightning,
> And nowhere was he,
> Thundering came the clouds,
> I remained UNMOVED ... ..

But, then, God, and her *Karma* are to be blamed. The lord never returned.

College and University Libraries must have this excellent volume, the preparation of which must have cost a lot of pure labour or love. The authors of the different papers and discussions have done a valuable service to the cause of sociology and anthropology.

R. NAGA RAJA SARMA.

(1) Technological Reports on Standard Indian Cottons, 1945. By Nazir Ahmad, Director, Technological Laboratory, Matunga, Bombay. (Indian Central Cotton Committee, Technological Bulletin Series A, No. 63.) Price Rs. 1-8-0.

(2) Technological Reports on Trade Varieties of Indian Cottons, 1945. By D. L. Sen, Officiating Director, Technological Laboratory, Bombay. (Indian Central Cotton Committee, Technological Bulletin Series A, No. 64.) Price Rs. 1-8-0.

1. The Bulletin No. 63 (perhaps the last by the present author), a useful annual feature of the Technological Laboratory of the Indian Central Cotton Committee, runs to 107 pages and is an authoritative compendium of the results of exhaustive tests on 19 Standard Indian Cottons of the season 1944-45. The Cottons are tested for their fibre characters. They are processed and spun under optimum conditions and the yarns tested for various properties. The results are given not only for the 1944-45 crop but also for the earlier seasons ever since the type was first tested as a Standard Cotton, sometimes dating back to 1926-27. These "Standard Cottons" "have no relation whatever with the trade standards" but "are mostly botanically pure types which are selected with special reference to yield, ginning outturn, fibre-properties and spinning performance" (p. 3). They are grown under known condi-

tions in Government Agricultural Farms and "include a few types from each Province" (p. 2). This comprehensive report marks the progressive development in the quality of the Indian cotton crop by the efforts of the Department of Agriculture.

The Report follows the usual lines with a short Preface, a Table of Contents followed by an explanatory Introduction about the objects of the tests, *viz.*, "to establish a scale of reference for the entire Indian cotton crop", "for the study of seasonal variations in the fibre properties and spinning performance", "to furnish the necessary data for the correlation of fibre properties of Indian cottons" with their "spinning performance" and "to place in the hands of the trade detailed information regarding the Standard Cottons" (pp. 6 and 7); the technique of processing and testing; and the plan of presentation of the results. Included in it are a few special features like (*a*) A Table of Characteristics of Indian Cottons (p. 2), (*b*) A List of Acreage of the Standard Cottons (p. 3) and (*c*) A Note on "Seasonal Variations of Standard Cottons" (p. 9). Individual detailed reports for the 19 Standard Cottons tested are then given. In each case the seasons during which it is tested, the agricultural details including acreage, the grader's report, fibre test results, sequence of machinery employed in spinning, the Spinning Master's report, remarks based on the test results, the highest standard warp count for which the cotton is adjudged suitable for the various seasons and details of spinning test results, are given. The Bulletin ends with highly useful consolidated tables of results of fibre tests in English and Metric units, for all cottons for all the seasons tested, along with a summary table of spinning test results from 1935 to 1945 classifying the cottons according to provinces of origin.

From p. 11, it is heartening to note that "there is a good deal of evidence to show that on the one hand the quality of the crop, as a whole, is improving from year to year, and on the other the area under standard Indian cottons is increasing steadily". From p. 12, it is noticed that on the whole, "a great majority of the cottons of the 1944-45 season, as represented by the samples sent to the Laboratory for tests, gave practically the same spinning test results as in the last season".

One special feature of the results, *viz.*, the difference between the roller-ginned and saw-ginned samples of Sind Sudhar and Sind American M4, is worth noting, the saw-ginned samples spinning better and always fetching much higher price (pp. 33-48).

It is felt that the utility of the report would be enhanced by the inclusion of a few items, *e.g.*, (1) In the table on p. 2, a column for yield per acre and another for production during the previous season. (2) In the list on p. 3, acreage for the previous year. (3) Definition of Highest Standard Warp Count, and the Standard Twist Constant employed. and (4) Photographs of evenness standards which would prove highly useful.

2. While Series A, No. 63, refers to the tests on 19 Standard Cottons only, No. 64 is a sister-bulletin referring to the tests on 39 samples of "Trade Varieties" of the 1944-45 Indian Cotton Crop. This also is an annual publication of the Indian Central Cotton Committee, the results being confined to spinning tests only. While the report on Standard Cottons assists the cotton breeder and the cotton scientist, these tests on "representative trade varieties" "renders more direct assistance to the cotton trade and the textile industry" (p. i). The objects of the tests are to provide "reliable information regarding the waste losses and the spinning performance of the chief types of Indian cottons" and for knowing "whether a particular variety of cotton was maintaining its quality or showing signs of improvement or deterioration" (p. i), to enable necessary measures to be taken.

The samples representative of the fair average quality of the season's crop of the whole country obtained mostly through the East India Cotton Association and the Mill Owners' Associations, are spun and the yarns tested.

The Report opens with a Table of Contents followed by an Introduction which deals with the objects of the test, the choice of samples and the plan of presentation of results. This is followed by detailed reports on each cotton, comprising the source of sample, seasons of test, sequence of spinning machinery, Spinning Master's report on cotton and yarn, the grader's valuation report and the table of spinning test results. The Bulletin running to 97 pages closes with a report on three varieties of African cottons "used in considerable quantities in the Indian mills" (p. viii).

The usefulness of this report as an immediate guide to the trade regarding the quality of the season's crop would be enhanced if its publication could be expedited securing early samples. Inclusion of the spinning value of each sample in the table of results would facilitate a comparative study of the behaviour of a variety from season to season. The acreage under each cotton and the Province of growth would be valuable information.

While it has been decided to issue a separate leaflet containing "comparative results for trade varieties and the corresponding standard cottons" (p. viii) the simultaneous publication of both would be helpful.

The trade should be grateful for the publication of these authentic reports of spinning tests conducted under reproducible conditions as they provide a valuable standard of reference for comparing the performance of the commercial crop under mill conditions.

The get-up of the Bulletins is of the usual high standard except that the paper used reminds one that it is yet a war-time publication! They are moderately priced at Rs. 1-8-0 per copy.

SRI NAGABHUSHANA.

SCIENCE NOTES AND NEWS

Rice Straw.—Rice straw, as cattle feed, becomes more digestible and more nutritive after it has been soaked in dilute caustic soda solution. The improvement in the nutritive value by this alkali treatment accelerates growth in cattle by 67-74 per cent. It has been found that the feeding of treated straw to young stock is economical the animals look healthier and enter into reproductive life earlier. The soaking and washing of rice-straw in plain water, although it does not produce the spectacular results of alkali treatment, is also benecial and the feeding value of rice straw is brought at par with that of the wheat straw.

Industrial Development.—MR. C. RAJAGOPALACHARI, Member for Industries and Supplies, presiding over a meeting of the Council of Scientific and Industrial Research, emphasised that the Board should aim at real help to industry. He deplored that India had to depend on other countries for food. He felt that things would have to be organised so that in the matters of food and clothing we should not depend on external assistance, and any industrial development in the country that would help this must have priority.

All industrialisation plans and schemes should keep in mind the unalterable facts of our population and our rural economy. But, it was not the intention that all-round scientific investigation should not be encouraged. He appealed to the scientists that they should not subordinate themselves to the whims and fancies of politicians however illustrious they may be. They should owe allegiance only to the Science and Truth.

The Governing Body of the C.S.I.R. sanctioned several new schemes of research on the recommendation of the Advisory Board costing about Rs 2,60,000. The schemes include Atomic research at the Tata Institute of Fundamental Research, Bombay, and the Bose Research Institute

The Governing Body approved the final plans for the establishment of the Fuel Research Institute and the National Metallurgical Laboratory in India. The Fuel Research Institute is to be located near Dhanbad at an estimated capital cost of Rs. 14 lakhs and the National Metallurgical Laboratory will be located at Jamshedpur with an initial capital expenditure of Rs. 42·8 lakhs. Architects for these laboratories have already been appointed by the Council and detailed estimates, plans and designs will be submitted by them for the approval of the Council.

The Governing Body noted with satisfaction that the Government of Bombay had agreed to the location of the National Chemical Laboratory on the Pashan Road at Poona and that the required land would be transferred to the Council for this purpose.

India will participate in the first General Conference of the United Nations Educational, Scientific and Cultural Organisation, to be held in Paris in November 1946. Sir S. Radhakrishnan, Vice-Chancellor of Benares Hindu University, will lead the Indian delegation which includes Rajkumari Amrit Kaur and three others, whose names will be announced shortly One will be a representative from the Indian States. The delegation will leave India at the end of October.

During the year (1945-46) the Millowners' Association of Ahmedabad have decided to establish a Research Institute for Textile Technology in Ahmedabad and for that purpose to raise a fund of Rs. 48 lakhs, to be subscribed to by member-mills on the basis of installed looms and spindles *plus* a certain percentage of the standard profits.

Extensive fruit and fisheries research is to be undertaken by the Imperial Council of Agricultural Research and the new Central Fisheries Research Institute. For the latter the Government propose to buy in the U.K. and U.S.A. four modern fishing boats and may also acquire a trawler from the Royal Indian Navy. Cold storage plants will also be bought abroad.

The establishment of a Rice Research Institute, which involves a non-recurring expenditure of Rs. 4,50,000 and a recurring one of Rs. 34,000 in 1946-47, is another item included by the Agricultural Department. The Central Institute, which will be located at Cuttack, will concentrate on fundamental research. An overall expansion and re-organisation of the Imperial Agricultural Research Institute is contemplated and for this a non-recurring grant of Rs. 32,97,217 and a recurring one of Rs. 2,32,667 in 1946-47 has been sanctioned, the estimated cost of the entire scheme spread over five years being Rs. 1,32,75,750.

GEOMAGNETIC STORMS

Some details of geomagnetic storms which have been recorded at the Alibag Observatory for the half year ending September 1946 and which have been classified as great or very great according to the standards of the Alibag Observatory have been given in the following table in which t_0, t represent the time (I.S.T.) of commencement of the storm and its intense phase respectively and T, the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field as recorded at the Alibag Magnetic Observatory during the storms have also been given, D, in minutes of arc and H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k-index k_m recorded during the storm has also been given.

Date	t_0	t	T	Range			k_m	Nature of commencement
				D	H	V		
1946	h. m.	h. m	hrs.	min.	γ	γ		
April 22–25	12 28	17 00	2)	11·7	345	87	6	Sudden
July 27	00 15	00 15	13	12·5	499	103	8	Sudden
Sept. 18–19	05 18	05 18	13	6·9	283	68	7	Sudden
Sept. 21–23	22 41	15 40 Sept. 22	9	8·2	425	146	9	Sudden
Sept. 27–29	About 11 30	18 00 Sept 28	7	5·3	222	57	6	Gradual

The geomagnetic storm of July 27, was remarkable for the sudden enormous initial rise of 147 gammas in H in about a minute and followed by rapid low-amplitude oscillations in all the three elements resulting in a number of peaks in both H and V. The story of September 11-23 recorded a number of large oscillations during its intense phase.

The Eastern Technical Institution will provide facilities for instruction for about 2,000 undergraduates and 1,000 post-graduate students. The Sarkar Committee, set up early in 1945, had recommended the establishment of four such higher technical institutions. The Eastern Higher Technical Institution may therefore, be regarded as a start in Government's programme of technical education, and it is understood that it will cater for the needs of all the provinces. The scheme will involve in the current financial year a non-recurring expenditure of Rs. 4,25,000 and a recurring one of Rs. 1,62,000, while the estimates for the three subsequent years are, non-recurring Rs. 91 lakhs, Rs. 1,04,50,000 and Rs. 1,05,20 000 and recurring Rs. 10,977,000, Rs. 26,79,300 and Rs. 39,52,000 respectively.

Dr. W. R. Aykroyd has been appointed Director of the Nutrition Division of the Food and Agricultural Organisation of the United Nations. Dr. Aykroyd was formerly Director of the Nutrition Research Laboratories at Coonoor.

The International Association of Wood Anatomists has elected Dr. K. A. Chowdhury, M.B.E., D.Sc., F.N.I., Wood Technologist, Forest Research Institute, Dehra Dun, to its Council. He is the first Indian scientist to be elected to the Council of this international organization.

Dr. Wali Mohamad has been appointed Vice-Chancellor of the Osmania University. Dr. Mohamad was formerly the Head of the Department of Physics, Lucknow University.

Dr. V. N. Patwardhan has been appointed Director, Nutrition Research Laboratories (I.R.F.A.), Coonoor.

Dr. Hugo Osvald, Professor of Plant Husbandry, at the College of Agriculture, Uppsala, Sweden, and Secretary of the Executive Committee of the Seventh International Botanical Congress, has been visiting the U.S.A. On July 20, he was the guest of the American officers of the Botanical Section of the International Union of Biological Sciences (the official holdover committee of the congress) at Harvard University, with whom he discussed plans for the next Congress. This will be held in Stockholm, in the early summer of 1950.

Dr. Frans Verdoorn, Botanical Secretary of the Union, has, at the request of the Executive Committee, undertaken to prepare a new international plant science register and directory (along the lines of the early volumes of *Chronica Botanica*), this will be issued about a year before the Congress.

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AGRICULTURAL RESEARCH AND RECONSTRUCTION*

THE task before us is of vast magnitude and we require the co-operation of every individual in the country for the vast task of construction which awaits us. Our main problem is to link our man-power with the vast material resources of the country and to develop them according to a plan. In planned scientific development lies the salvation of the country and in this great task scientific research workers, particularly those who have chosen agriculture and animal husbandry as fields for their activities, have a great task to perform.

There was a time when India was said to be flowing with milk and honey. Recently we have had to pass in Bengal through a period of famine which took a heavy toll. The immediate task, therefore, before us is to step up food production so that all persons in this country have two square meals a day. The war and famine in Bengal have brought home to us the marginal nature of our food production in a rather tragic manner. Now our task is to rectify this ill-balance between population and food production by producing better and more food. Research workers in India must concentrate on the task of evolving better and high yielding varieties of crops, in discovering better cultural practices and in placing more efficient tools in the hands of the cultivator. In our search for better tools and means of irrigation we should not forget that those will not be utilised unless they are such as our ordinary cultivator can afford. While concentrating multi-purpose dam irrigation schemes not only to provide irrigation for our thirsty lands but also cheap power for agriculture and industry, we should not neglect to improve the well, the rivulet and the tank and must find ways and means such as cheap and efficient pumps which can be worked with the help of power—human and other animal—which are available and within the competence of the Kisans of India.

Agriculture is the most important industry in the country which gives employment to masses of people and provides food for the entire population. Agriculture and food should have the highest consideration and agricultural research, which places in our hands means of increasing the food supply of the country, should have the highest priority and no amount of attention given to its advancement can be too great. We may remember that agriculture in India is entirely dependent on bullock power and is bound to remain so in the foreseeable

* Abstract of an Address delivered by Dr. Rajendra Prasad, Hon'ble Member in charge of Food and Agriculture, to the Sixteenth Meeting of the Governing Body of the Imperial Council of Agricultural Research, on 25th September 1946.

future. The cow and her progeny, therefore, claim and should get our attention so that there may be not only a plentiful supply of milk which is such an essential item of balanced diet but also of strong and healthy bullocks necessary for efficient cultivation and other draught purposes.

Since its birth in 1929, the Imperial Council of Agricultural Research has performed great service to the people. Agricultural research in this country has provided high yielding sugarcanes, wheats, cottons, and paddies to the cultivator but we must recognise that even in respect of these our production is very much less than what it is in other countries, as the following comparative statement will show.

Average yield per acre (in lbs.)

	India	Argentine	U.S.A.	Canada	Italy	Egypt	Japan	Java	Peru
			Aveiage Yield per Acre (in Lbs.)						
Wheat	636	780	846	972	—	—	—	—	—
Rice	851	—	1333	—	2797	1845	2124	—	..
Cotton	89	151	264	—	—	531	—	—	—
Sugarcane	388 (in maunds)	—	—	—	—	—	—	1446	1160 (in maunds)

We have, therefore, no reason to rest on our oars and further and more intensive work which will help the ordinary Kisan to increase the yield is necessary. I recognise, however, that but for the efforts of research workers the shortages in respect of some of these products that we are experiencing now would have been greater still.

The Imperial Council of Agricultural Research provides a meeting ground where Ministers of Agriculture of Provinces and constituent Indian States, representatives of Central Legislature, Indian and European Commerce and of the Government of India, can discuss problems of agricultural research and guide, co-ordinate and promote research. One of the main functions of the Council is to place at the disposal of research workers throughout India experience of their fellow-workers in this country as well as scientific and technical information derived from foreign countries. The Council also acts as a clearing house of scientific knowledge on the problems of agriculture and animal husbandry. It has provided an organisation for pooling ideas and techniques so that the whole of India may benefit from the experiences of every part. Science cannot flourish in isolation. The best brains of the country must be brought together so that they may be able to exchange views and experience and to pool knowledge. On the Advisory Board of the Council and its Committee the scientific and technical side of agriculture and animal husbandry research in the country is represented, while the Governing Body controls policy and finance. By promoting, guiding and co-ordinating agricultural and veterinary research in India, by training research workers and collecting and disseminating information on research through its publications, the Council has been performing a useful function.

Ultimately, all research must be judged from the contribution it makes to the welfare of the masses. A poor country like India can ill-afford ivory-tower research divorced from the realities of life and the needs of its cultivators. It is the needs of the cultivator which research workers must always keep in view. 'Science in the service of the country' must be our ideal. It is generally admitted that investment in scientific research is the best investment which a nation can make as the returns which it provides are out of all proportion to the money invested. As an example we may cite the case of sugarcane development in this country which has saved the drain of millions of rupees to foreign countries. I can give you the assurance that this Council will have all my support and sympathy.

NATIONAL RESEARCH LABORATORIES

INDIA'S scheme to set up four more National Laboratories at an estimated capital cost of Rs. 132 lakhs is being launched. The plans for these were approved recently by the Governing Body of the Council of Scientific and Industrial Research.

The Hon'ble Mr. C. H. Bhaba, Member for Works, Mines and Power in the Interim Government, laid the Foundation Stone of the Fuel Research Institute at Digwadih, near Dhanbad, on November 17. The capital cost of the Institute, is estimated at Rs. 14 lakhs.

The Hon'ble Mr. C. Rajagopalachari, Member for Industries and Supplies, and President, Council of Scientific and Industrial Research, laid the Foundation Stone of the National Metallurgical Laboratory at Jamshedpur on November 21. The initial capital expenditure on this laboratory will be about Rs. 43 lakhs.

The Foundation Stone of the National Physical Laboratory will be laid by the Hon'ble Pandit Jawaharlal Nehru, Vice-President, Interim Government, on January 4, 1947, at Delhi, during the Indian Science Congress Session. The estimated cost of this laboratory is about Rs. 40 lakhs.

The Hon'ble Mr. B. G. Kher, Prime Minister, Bombay, will lay the Foundation Stone of the National Chemical Laboratory at Poona sometime towards the end of January 1947. The Government of Bombay recently agreed to the location of this laboratory in Poona and the transference to the Council of the land required for this purpose. The Chemical Laboratory is expected to cost Rs. 35 lakhs.

The first of the five National Laboratories planned for the industrial development of the country was the Central Glass and Ceramic Research Institute costing about Rs. 12 lakhs. The Foundation Stone of this was laid by Sir Ardeshir Dalal, former Member for Planning and Development, Government of India, in last December at Calcutta.

HALF A CENTURY OF RADIO COMMUNICATIONS
(1896–1946)

By Prof. S. P. CHAKRAVARTI
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I. Introduction

ALTHOUGH the period of 65 years from 1830 to 1895 has to its credit a number of fundamental contributions relating to nature. generation and detection of electro-magnetic waves by well-known mathematicians and physicists like Faraday, Kelvin, Clerk Maxwell, Oliver Lodge, Elihu Thomson, Hertz, Fitzgerald, Righi, Branley and Popoff, the year 1896 can only be rightly called the beginning of the age of radio communication.

In 1896, Marconi, a student of Prof. Righi, came to England to conduct his first experiments between the G.P.O. and a site on the Thames Embankment in London, with a view to establish commercial systems. In the same year, he took out his first British Patent relating to wireless telegraph communication which led to the foundation of the present Marconi's Wireless Telegraph Company Ltd. As a result of his experiments, his system was adopted at many places about 1898. The first commercial radio telegraph message was sent on 3rd June 1898 by Lord Kelvin from the Isle of Wight to Bournemouth. In 1899, Marconi made history by transmitting a message over 32 miles across the English Channel.

In Germany, Prof. Braun, working on a system similar to Marconi's, introduced in 1898 a special oscillation circuit, the spark circuit, to which the aerial was connected. The introduction of the Braun circuit known as the "intermediate circuit" separated the functions of generation of H.F. oscillations and radiation. In 1897, another system—"Slaby Arco"—was born in Germany but was later on merged with the other into one under "Telefunken". The weakness in telefunken system was later on overcome by Prof. Wien by his system of "Quenched Spark".

These modest beginnings led to an era of considerable advancement in technique and application relating to every possible branch of radio communication. It is proposed to review the period under two sub-periods 1900-24 and 1925-46.

II. Radio Communication During 1900-1924

(*a*) *Radio-Telegraph and Telephone Communications.*—The year 1900 saw Marconi's patent for "Syntonic Telegraphy". The range was now increased to over 200 miles. Fleming (later Sir John A. Freming) who was now associated with Marconi had much to do with the installation of the historic station at Poldhu (Cornwall) for communicating with St. John (Newfoundland). On 12th December 1901 Marconi and his assistant transmitted the letter "S" over 1,800 miles, and in January 1902 sent a message over 3,000 miles from Cape Cod (U.S.A.) to Poldhu (Cornwall). The transmission wave-length was increased to 4,000 metres.

Apart from attaining perfection in rotary gap, synchronous gap and quenched spark systems on the transmitting side, a number of detectors like magnetic detector, electrolytic detector, crystal detector, etc., were invented. Fleming's thermionic diode valve came in November 1904.

About 1904, the position was that Marconi's W. T. Co., Ltd. installed a 150 KW long-wave station at Wales to work with another similar station at New Brunswick, and a second station of this type at Norway to communicate with another one at Marion, Mass. The transmitters were of "Synchronous Gap Type" and the receivers incorporated Fleming's "diodes". In 1907, commercial trans-Atlantic telegraphy on long-wave (employing Marconi's system) was inaugurated between Nova Scotia (Canada) and Clifdon (Ireland). 80 KW long-wave station on Telefunken system at Karlsborg worked with other continental stations.

Poulsen arcs (with modifications by Barkhausen and Pedersen) and rotary alternators due to Goldsmidt, Alexanderson and Fessenden which came between 1902 and 1907 furnished the engineers with sources of continuous waves. With Poulsen arc in hydrogen gas, a frequency of about 1,000 Kc/S should be reached. The arc transmitters were generally made for powers from 30 KW to 3,000 KW for wavelengths from 600 to 23,000 metres. In 1923 there were 80 stations on the Poulsen Arc system distributed over the whole world, the biggest being Malabar 3,000 KW, and Shanghai and Bordeaux 1,000 KW each. R.C.A. standardised their H.F. alternators for 200 KW and frequecies from 15-22 Kc/S. Telefunken Co. used Alexanderson system with frequency multipliers at Nauen in 1919, and Sweden's first radio-telegraph system with U.S.A. was established with this system in 1924.

In 1907, Lee De Forest invented the three electrode valve (with properties of amplification and oscillation as well as detection) which revolutionised the whole system of radio communications. The "Dynatron Effect" and the invention of screen grid valve by Hull followed in 1915-16. In 1908, Armstrong perfected his regenerative circuit with three-electrode valve, and later on established his method of super-regenerative, heterodyne and superheterodyne receptions. Experiments were carried on the amplitude modulation of high frequency carrier wave by speech and music by several workers like Round, Fessenden and Hesing. Thus, the foundation for valve transmitters and receivers for telegraphy and telephony was laid.

Marconi station at Carnarvon (Wales) using valves was opened in November 1921 for telegraphic communication between Great Britain and Australia. First trans-Atlantic radiotelephone tests (using long-wave, 60 KW, single side band system) were conducted in October 1915.

(*b*) *Radio Broadcasting.*—With the end of the World War I in 1918, began the era of Radio Broadcasting. In early 1920, the first broadcasting of musical items in Great Britain took place from Marconi Company's Chelmsford Works. Regular radio broadcasting was made from Marconi stations at Chelmsford and Marconi House (London) in 1921 and 1922 respectively before the establishment of B.B.C. in the later part of 1922. Broadcasting was

born in the United States in November 1920. On that day, station Kdka in East Pittsburg inaugurated the first broadcasting service in U.S.A. In France, regular broadcasting was begun from 1921 from a military station in Eiffel Tower, and in the following two years it started in other European countries.

(c) *Radio Direction-Finding*.—The directional properties of open and loop aerials were studied by Braun, Weagant, Marconi, Pickard, Bellini and Tosi in the opening years of the present century. Radio methods began to be employed for direction-finding during the period under review. Use of rotating frame aerial was made by Braun, whereas Bellini-Tosi developed their radio-goniometer. Adcock modification of the Bellini-Tosi system made during the World War I was applied to the commercial field a few years later. Marconi-Bellini-Tosi compass, Telefunken wireless compass, U.S. Navy radio compass, etc., were evolved during this period. Robinson's method of direction-finding was patented in 1918. Ideas on the use of radio beacons were fast dawning.

(d) *Marine Radio Communication*.—About 1899 big Atlantic passenger liners began to instal in them radio-telegraphic stations mostly of Marconi's make. On account of its having the fixed radio stations on the European and American Coasts, the Marconi Company was even at this early stage at an advantageous position with regard to ships' radio traffic. Some passenger vessels were also fitted up with radio system of the Telefunken type and a few of them with that of R.C.A. type. By 1909 most of the important passenger vessels had been equipped with wireless apparatus majority of them being of Marconi make. The first conference solely relating to marine radio communication was held at Berlin in 1903. Subsequently, this subject received due attention at subsequent international radio conferences held in Berlin and London in 1906 and 1912 respectively. The total number of coastal and ship stations was 3,280 and 9,050 in 1913 and 1920 respectively.

(e) *Radio Transmission of Pictures*.—Even the radio transmission of picture was carried out during the period under review. In November 1924, the Marconi Company in collaboration with the R.C.A. successfully transmitted photographs of the Prince of Wales, President Coolidge and Mr. Charles Hughes by radio. which were reproduced in *New York Times* and *Daily Telegraph* of 16th December 1924.

(f) *State of Knowledge of Radio-Wave Propagation*.—A modification of Hertz's formula was evolved for short distance propagation over flat earth of finite conductivity. For long distances, attempts were made by mathematicians and physicists to deduce formulæ for field strength by taking into account the curvature of the earth's surface, but formulæ so obtained were found inadequate to explain the observed values. In 1902, Kennelly and Heaviside simultaneously suggested that upper atmosphere rendered conducting by sunlight might cause such deflection and force the waves to follow the curvature of the earth. Therefore the wave propagation in the space between two concentric conducting spheres was considered but the results again failed to agree with the measurements. The best theoretical-*cum*-empirical formula of the period was the Austin-Cohen formula.

The above review of radio developments during 1900-24 will show that the Spark and Arc type transmitters were replaced by valve transmitters and the wave-responding devices like coherer, magnetic, electrolytic and crystal detectors by valve receivers. It will also be noted that radio-telegraphy and telephony, broadcasting, telephotography, direction-finding and marine communication were in commercial operation during this period. The allocation of wave-band agreed upon about 1920 was as follows:—20,000-3,000 metres for trans-continental telegraph and telephone communication, and 3,000-200 metres for broadcasting and marine communications.

With the end of the World War I and growth of radio broadcasting, a large number of amateur experimenters were not satisfied with merely listening to the broadcast programmes but wanted to work experimental transmitters of their own. They were allocated the wave-band below 200 metres which was then considered useless for serious work. The amateurs used low power and increased the range of their transmission more and more by making the wave-length less and less. Very soon astounding reports of two-way communication between lands separated by wide seas as well as observations for associated phenomena like fading, etc., appeared in papers. Marconi and Franklin made thorough investigation on the propagation of radio signals on wave-lengths below 100 metres. His experiments from Poldhu on 97 metres with parabolic reflector aerial and receiving point on his yacht 'Elettra' could give satisfactory results over considerable distances. He began trials during 1916-19 with wave-lengths from 2 to 15 metres and demonstrated the quasi-optical character of ultra-short waves.

III. Radio Communication During 1925-46

(a) *Radio Telegraph and Telephone Links*.—About 1924, the British Post Office had been planning a long-wave telegraph system with Canada, Australia, India and South Africa. Marconi then took up the boldest step of his life and succeeded in inducing the B.P.O. to give up their plans for long-wave network and accept a new system using short-waves between 10 and 35 metres on the beam principle. Marconi's own experience with directed short-wave beam and his extraordinary intuition gave him courage to sign the contract. The work of construction that followed involved a multitude of problems in respect of transmitters, receivers and aerials, all of which were solved with success. On 25th October 1926, the Canadian beam was opened and other connections came into being the following year. The success with the short-wave was so complete that the competing telegraph cable companies lost a great deal of their traffic resulting in a "merger company" in 1928. In addition, short-wave telephone links connecting Britain with other countries were opened in 1928 and following years. The path shown by Marconi and British Post Office was quickly followed by U.S.A., Germany, France, Spain, Russia, Japan, South America, etc. Table I roughly shows the number of intercontinental radio-telephone circuits of the world, existing and proposed on January

1, 1932. The longest of the circuits is between (London) Britain and (Sydney) Australia, having 17,000 Km. distance.

TABLE I

No.	Countries or continents in or between which circuit exists	No. Existing	No. Proposed
1	North America—Britain	4	2
2	North America—Europe	-	1
3	North America—South America	2	3
4	Britain—South America	3	—
5	Europe—South America	11	2
6	Europe—Africa	2	10
7	Britain—Asia	—	4
8	Britain—Australia	1	—
9	Europe—Asia	5	1
10	North America—Asia and —Australia	1	3
11	North America	1	5
12	South America	3	1
13	Asia—Australia	4	1

In addition to the above, there has been further extension of radio-telephone circuits till the outbreak of World War II. Among them may be mentioned the Paris-Moscow, South America-Japan, Europe-Japan, Europe-South America, Europe-Near-East, U.S.A.-Switzerland, and U.S.A.-France telephone links which were opened immediately before the war.

The valve transmitter equipment upto 1924 or so generally consisted of self-oscillator (of large power at the transmitting frequency) and modulator system. Subsequent to 1924, it was changed to a master oscillator (either tuning fork or crystal controlled, or Franklin master oscillator) followed by separator, frequency multipliers and radio frequency power amplifiers (or driven circuits), and the modulation was applied either at low-power or at high-power r.f.-driven stage. Transmitters delivering upto 60 KW to aerial at these wave-lengths were developed. Transmission of carrier and both side bands was employed in earlier short-wave telephone links, but in later ones only "single side band" was transmitted. The valve receiving equipment was of super-heterodyne and double super-heterodyne types for telephone and telegraph systems respectively. Commercial telephone links were fitted up with "Voice-Operated Differential Anti-Singing Device" and "Privacy or Secrecy Device". Considerable studies and development took place in this connection on antenna arrays (including Sterba, Marconi, T.W. and horizontal arrays) and rhombic antennas during 1926-35. For high voltage power supply to the final and penultimate stages of transmitting system, increasing use of grid-controlled mercury arc rectifiers of steel tank and glass bulbs types was made during this period.

Experiments on "multi-channel working" (simultaneous telephone and telegraph) were carried out on the Madrid-Buenos Aires short-wave radio link, and they proved successful as by use of inverters and spreaders in the telephone channel and by appropriate allocation of frequencies telegraphy at 125 words per minute was possible at the same time as speech. Multi-channel operation was then applied to a few other links. Multi-channel operation (giving 9 telephone channels simultaneously) was adopted with great success on "ultra-short-wave radio-telephone links" installed to work with the trunk telephone networks of the various countries. The year 1937 marks the introduction for the first time of a multi-channel unattended remote-controlled radio link in the regular long-distance telephone network.

Transmission of pictures over radio links in U.S.A., Japan and on the Continent of Europe as well as over some of trans-continental links was carried out with success. An equipment like Acme Facsimile equipment (modified for radio circuits by Marconi Co.) was used at the terminals for the purpose.

To get over the difficulty due to severe attenuation on short-wave trans-continental links at the adverse periods of the sun-spot cycle, erection of high gain directional aerials was taken up. An array of rhombic antenna (known as multiple unit steerable antenna) was designed for the receiving stations to obtain an additional gain of 12 to 15 db in signal to noise ratio for 40 to 50 per cent. of time during sun-spot periods in order to maintain the circuits at a commercial level.

(b) *Marine Radio.*—During this period, practically all ocean-going vessels were equipped with transmitters and receivers as well as directiion-finding equipments. The most substantial advance in mobile services made during this period was "Ship-to-Shore Telephony". The wave-lengths used varied from 90 metres or so to about 18 metres depending upon the distance over which communication was carried on. Ship-Shore and Shore-Ship telephone services were first opened in 1929 between S.S. "Leviathan" and the United States and between S.S. "Majestic" and England. In 1930, they were extended to include S.S. "Majestic" and the United States, S.S. "Leviathan" and Europe, and S.S. "Olympic" and S.S. "Homeric" with countries on both sides of the Atlantic. These services were made possible with co-operation of the B.P.O., the American T. & T. Co., and International T. & T. Corporation.

Mackay Radio & Telegraph Co. opened a number of ship-to-shore telegraph stations on the Atlantic Coast of U.S.A. In 1932 this Company operated radio service of 215 American merchant vessels. The International Marine Radio Company operated the wireless Services of the trans-Atlantic fleet of the Cunard Steamship Company as well as of 160 ships installed with radio apparatus of various types. Several types of transmitters and receivers were developed for use on ships as well as in coastal stations by International T. & T. Corporation, Federal Telegraph Co., and International Marine Radio Co.

About 1939, International Marine Radio Co. Ltd., introduced the first commercial telegraph transmitter providing high quality service on all marine telegraph frequency bands. Design features of the new transmitter include variable tuning, master-oscillator control over the whole frequency range (16·9-55, 583-820, and 1875-2,800 metres) with optional crystal control on a number of spot frequencies. Another interesting development about the same time

was that of a 135-watt marine radio beacon equipment satisfying the widely varying requirements of a number of countries.

(c) *Aviation Radio.*—This relates to radio transmitters, receivers, altimeters, direction-finding (guiding) and landing instruments on the aircraft as well as radio transmitters, receivers, direction-finding and landing equipment at ground stations. Aviation at an early stage made use of radio direction-finding both in the aircraft and on the ground. For night flying, the direction-finding system employing Adcock modification was used from 1926. About 1930, the European countries came to agreement for a common triangle network of radio beacons for the benefit of aviation. The problem of "blind landing" was solved in principle about 1930, and the solution was taken up for development by C. Lorenz, A.G., Berlin.

Even about 1935 practice in Europe regarding aviation radio equipment was not standardized to anything like the extent to which it had been in U.S.A. and there was no agreement till then as to the most advantageous type of radio equipment for aerial navigation. Experimental equipment like "several types of homing beacon", "ultra-violet-wave blind-landing gear of the Lorenz pattern", "automatic direction-finders for use in aircraft", etc., was on trial. In 1936, the Lorenz system was adopted in Europe, Far-East, Australia, South America and South Africa, and in 1937 there were 35 air port and 200 aircraft installed with this equipment. In the following year, "Z" and "Fan" maker beacons using frequencies of the order of 75 MC/S were introduced along routes in U.S.A.; the Australian authorities accepted a plan for using U.S.W. frequencies for range navigation and blind approach beacons, and Lorenz blind approach system was installed and demonstrated at Indianapolis, U.S.A. In 1938-39, the Lorenz system with certain modifications as to wave-length, etc., was adopted all over the U.S.A.

Unlike the Europeans, the Americans directed radio beacons between the airports. During the World War II, through co-ordination of European and American air radio systems at the world conferences in Chicago in 1944 and Montreal in 1945, new aids for long-distance aerial navigation such as "echo-radio collision averters" and "Loran system" had been added. Further research on the landing system—a system for glide path indicators—working on 45 cms and employing an equi-modulation path was taken up in U.S.A. New models of Standard-Busignies "Automatic Radio Compass" with the extension of the frequency range to include band 150-1,500 KC/S had been produced to enable the pilot to take bearings on broadcast stations. A small hand-operated loop direction-finder, combined with a "homing course indicator", was also developed by S.T.C. Ltd., London.

About 1936-37, for communication purpose the tendency was to use transmitters of higher and higher power both on medium and short-wave bands. The K.L.M. in 1937 introduced 200-watt equipment for medium and short-wave telegraphy on their routes to Batavia. Standard Telephones & Cables Ltd., London, completed in 1937 the development of a radio-telephone equipment with remote control system for fighter aircraft. The expansion of civil aviation and hence the need for radio channels for communication purposes resulted in wider adoption of crystal control for transmitters. Transmitters for civil aircraft were equipped with upto 10 crystal-controlled spot frequencies. The demand for radio communication for private aircraft led to allocation of wave-lengths in the ultra short-wave band. About 1932-33, a micro-ray communication system operating on 15 cm wave-length was installed for the British Air Ministry to work between Lympne and St. Inglevert aerodromes. It was to be used for announcing the arrival and departures of planes and for routine service messages. It was the first commercial application of the micro-ray communication system.

(d) *Radio Direction-Finding.*—Most of the direction-finding equipment developed during this period were covered under 'Marine Radio' and 'Aviation Radio'; and, therefore, this section would now be dealt with in brief.

Direction-finding by reception method.—Loop direction-finder was followed by Marconi-Bellini-Tosi system of direction and sense-finding and subsequently by Marconi-Adcock system for operation on medium and short-waves. Other developments during the period were the cathode-ray direction-finder, spaced-loop direction-finder, pulse direction-finder system and compensated loop direction-finder. In addition, "Homing Device" and "Automatic Radio Compass" were invented and proved valuable.

Direction-Finding by transmission method.—Radio beacons developed at the beginning of this period were considerably improved and new types as discussed in previous sections were evolved.

Other radio aids to aerial navigation were—(1) Radio Range on long and U.H.F.-waves, (2) Makers of various types to increase usefulness of (1), (3) Altimeters and (4) Instrument Landing Systems.

(e) *Radio Broadcasting.*—Radio Broadcasting which originated about 1920 in Europe and America had phenomenal growth in many countries during its short career of about 25 years. Its importance from view-point of (1) education, (2) spread of information and culture, (3) entertainment, (4) publicity and (5) propaganda, was fully realised everywhere. It was recognized as a powerful tool in the hands of the State both during peace and war. In Great Britain and most European countries, Canada, Australia and Japan, the organization of broadcasting was a national monopoly in the sole interest of the nation. In the U.S.A. it was in the hands of private enterprise. In India and some other European and Asiatic countries it was controlled by the Government.

The medium-wave band 200-545 metres was used for broadcasting. In addition, a portion of the long-wave band 1,000-2,000 metres was allocated for broadcasting in temperate countries and short-waves were allowed for broadcasting in tropical and semi-tropical countries as well as for "Overseas" broadcasting. The C.C.I.R. Conferences at Madrid and Cairo were most important so far as allocation of channels was concerned. In temperate countries the "regional" and "national" broadcasting was on medium and long-waves respectively. In tropical and semi-tropical countries the "regional" and "national"

broadcasting was on medium and short-waves respectively. For Overseas broadcasting, short-waves were used on the beam principle. The total number of medium-wave stations in the whole world in 1939-40 was about 2,200, with the antenna power in watts per sq. kilometre about 0·1. A large number of short-wave stations were installed in India, China, Iran, East Indies, Near-East, South American countries, etc. Overseas broadcasting on short-waves was carried out from England, France, Germany, Russia, Japan, India and North America.

From 1925 to 1934, modulation at low-power level was generally in great favour with broadcast transmitters. Since 1935, with increase in power of the transmitters, high efficiency modulation systems had been holding the field. "High power class B system" was employed widely all over the world. "Doherty System" was applied to some transmitters in America, while "Chireix System" was in use here and there on the Continent of Europe. Series modulation at penultimate or final stage, invented by Ditcham of Marconi Co., was applied to several Marconi transmitters (*i.e.*, installed at Droitwich, Motala, Delhi, etc., about 1935).

The extent to which this trend toward high power had already made itself felt was shown by the fact that about one in seven of 250 existing medium and long-wave stations in 1937 in Europe and North Africa were rated at 100 KW or over, and about one in four at 50 KW or over, while 55 per cent. had a rating of not less than 10 KW. Two 150 KW M.W. transmitters were installed in Japan about 1937. In U.S.A., where broadcasting did not receive financial support from the Government sources, the use of high power stations was not so widespread but transmitters with outputs of 50 KW were not uncommon and manufacturers had in hand about 1938 designs for medium-wave transmitters upto 500 KW. This trend towards high power was also shown during 1938-45 in short-wave transmitters which were built for ratings as high as 100 KW. "Inverted radio frequency amplifiers", originally developed for television transmitters, were used in B.B.C. Empire station 50 KW short-wave transmitter and in Rome station 10 KW S.W. transmitters about 1939. The grid-controlled H.V. mercury arc rectifiers of steel tank type found increasing use in transmitters. The Marconi Co. developed a power-saving arrangement, called "the floating carrier system" which was incorporated in many transmitters. Mast radiator of series and shunt excitation types developed for medium-wave broadcasting to prevent the sky (high angle) ray from interfering in the service area became quite popular. Reception of short-wave signals by "space and frequency diversity methods" and re-radiation of programmes on medium-waves became fully established in many countries.

A tuning fork control system for "common wave-length broadcasting" was installed to control the wave-lengths of Frankfurt-on-Main, Trier, Kassel and Freiburg stations. Several more networks of the type were introduced in other European countries. Two or more broadcast transmitters occasionally modulated with identical programme were operated with their carriers synchronised.

After the Cairo Conference (1938), broadcasting wave-lengths were discussed at Montreaux (1939) and a new plan for the European Zone was evolved. Much attention was given to the use of the synchronising systems, anti-sky wave and directive aerials to utilize the limited number of channels available to the best advantage. The plan for 1940 included an extensive use of these methods with an increasing number of high power stations and involved 61 groups of synchronized networks and 48 cases of directive aerials for the European Zone.

Prof. Easu of Germany was perhaps the first to test the usefulness of wave-lengths below 10 metres for broadcasting in cities during 1929-30. Experiments with ultra short-wave A.M. system for local broadcasting on 7·85 m were also carried out in Holland during 1930-31, and its advantages realised. Ultra short-wave F.M. (Frequency Modulation) broadcasting on frequencies 42-50 MC/S became very popular in U.S.A. and a large number of F.M. stations on Armstrong and Crossby systems had been installed. Experiments were also carried out on 84-112 MC/S and 100-165 MC/S bands. Pulse Time Modulation system, invented in U.S.A. during 1945, was capable of transmitting a large number of broadcast programmes simultaneously with a carrier frequency of the order of 3,000 MC/S.

The straight and reaction types of broadcast receiving set for long and medium-wave bands evolved in the beginning of this period were replaced by modern superheterodyne broadcast receivers for operation on long, medium and short-wave bands. The modern receivers incorporated many features like automatic volume and frequency controls, tuning indicators, push-button tuning, band spread, stabilisation of frequency calibration, negative feed-back, etc. Considerable attention was given to the development of F.M. broadcast receivers. It was now possible to have a broadcast receiver for F.M. signals on 42-50 MC/S and A.M. signals on short and broadcast wave-bands. Further studies were made on super-regenerative receivers in U.S.A. and Japan for ultra-short-wave reception.

(*f*) *Television.*—The possibility of seeing events at places remote from the observer was a dream of humanity for many centuries. The technical advances during the period under review made this dream an accomplished fact.

A number of workers made their contributions to this field, among them may be mentioned Campbell Swinton, Kerr, Baird, Zworykin, Dieckmann, etc. The "high definition television" was accomplished by 1935-36. Modern method of scanning by electron beam (using inter-laced scanning) was evolved. Emithron Television and Baird Electron Cameras were developed. Outdoor broadcasts had started in several countries since 1937. Special type of U.S W. transmitter to handle this large band was developed. The Marconi-EMI high definition system as used at the Alexandra Palace, London, transmitted 50 picture elements per second each of 405 total lines. Over half a dozen cameras were used. The feeble signal from the camera after amplification in an unit built into the camera itself was passed with

synchronising impulses through six stages of amplifiers designed to give linear amplification over 4 MC/S range. Two final stages in modulation amplifier employed high power water-cooled valves which were arranged to modulate the final stage of radio frequency transmitters. R.F. circuits of the vision transmitter at Alexandra Palace consisted of a Franklin temperature-compensated M.O. followed by a doubler and five stages of r.f. power amplification at 45 MC/S, peak output of the transmitter being 17 KW. About 1937, Thomson-Houston high definition system installed by French P.O. in Paris gave 50 picture elements per second each of 455 lines and the vision transmitter gave 30 KW peak power on 46 MC/S. There was an advancement in the "intermediate film pick-up" in Germany. By means of a mechanical scanner, electron multipliers and a special process, a film scanner was produced which photographed, developed and transmitted the picture within 16 seconds of the action. About 1939, National Broadcasting Company made a start with experimental television broadcasts using a transmitting antenna on the top of the Empire State Building in New York. From 1938 for the outside broadcasts two mobile units equipped with transmitters and receivers were used in London and the signals from them were received at Highgate whence they were conveyed to the Alexandra Palace at vision frequency on the television cable.

Experiments on two-way television transmission were carried out in U.S.A., Great Britain and on the Continent on the co-axial cables. With the invention of the Pulse Time Modulation system, it would be possible to work both one-way and two-way televisions on micro-wave carrier over very great distances by use of "radio repeaters" installed at short intervals.

A large number of manufacturers in U.S.A., Great Britain and on the Continent put in the markets during 1938-40 television receiver sets, prices ranged from about £40 to 100 per set which were not high considering circuit involved They consisted of two or more stages of carrier frequency amplification, frequency changer, five or more stages of I.F. vision amplifier coupled together by band-pass filters and a second detector of special low impedance diode valve. The output of the detector contained the picture signals and the synchronising impulses, and the picture signals were made to control the intensity of the light spot on cathode-ray tube in the set. The scanning sequence was accomplished by two sets of deflecting plates connected to linear generators and the synchronising impulses locked the scanning circuits of the receiver with those of the transmitter.

(*g*) *Radar and Associated Systems.*—The most phenomenal achievement of the World War II (1939-45) was the Radar. The fundamental principle of Radar—the location of a distant object by obtaining its range, bearing and elevation (with respect to the observer) with the help of the reflected impulse-modulated radio-wave and its basic technique were no doubt simple, but around this phenomenon had grown up so many complex applications varying widely in function and technique that they constituted a new specialised branch of radio and electronic engineering. As during the war period, most of the work on Radar was done through British-American collaboration, only the developments in one country, namely, Great Britain, need be reviewed here. Dr. Sir Watson-Watt was the central figure associated with this work. It was known as early as autumn of 1935 that range, bearing and angle of elevation could be measured by radio-waves of wave-length about 10 metres for an aircraft by a single combined transmitting and receiving station. The radio-location station measured in 1935 range to 1 Km and bearing to 1½ degrees at 60 Kms. Angle of elevation to ¼ degree could be measured in 1937. Towards the end of 1935, the "Home Chain Stations" on wave-lengths 10 to 12 metres were opened on the eastern coast of England. In 1938-39, Butement in England experimenting on radio-location station on 1·5 metres for ship location recognized this as solution of the problem of detection of low-flying aircraft. Another home chain of stations on 1·5 metres was opened soon after.

In 1940, several concerns, in co-operation with the Research Establishments of the Air Ministry and Department of Supply as well as the various universities (specially Birmingham University), were called upon to carry through a research programme leading to the development, design and construction of the "Centimeter Radar" for anti-aircraft fire control, searchlight work, and use on aircraft and ship. In 1941, one company developed a 50 KW, 10 cm equipment known as GL3 for A.-A. fire control. Experiments were started in 1941 at M.O.S. Research Establishment on the automatic following of aircraft by Radar Equipment, leading to development of "Glaxo". In 1944, with V-1 threat on London, the development and manufacture of a small Radar Unit working in 10-cm band known as "Cupid" (transmitter-receiver in which being mounted above the predicator) were carried through successfully. Many types of air-borne equipment like H 2S system—an extension of P.P.I. (Plan Position Indicator) system—were designed and manufactured.

The heart of the centimetric Radar—the "high power magnetron" working on the cavity resonance principle—was developed on the basis of work by research groups at Birmingham University and General Electric Co. These magnetrons could be built to generate up to 2,500 KW on 10 cm wave-length and 100 KW on 3 cm wave-length. Mercury vapour thyratrons were developed for Radar modulator work. Stable crystal valves to be used as first detector or converter, Klystrons (invented by Varian Brothers in U.S.A.), dielectric guides, etc., were all extensively studied and developed during 1940-45.

The years 1940-45 also saw development in "Servo-mechanisms" for accurate remote position control for searchlights, guns and Radar aerial system. For insulation of centimetre wave aerials and other components, the well-known low-loss material—"polythene"—was invented and widely used.

Several other navigational systems based on Radar or pulse transmission technique, namely,

Radar Beacons, Beacon Navigation systems, ("Oboe", "Gee-H", "Shoran", and "micro-H" systems), Gee and Loran, were developed. Radar proved not only to be a powerful weapon during the war period but would continue to do so during the peace time in various fields.

In addition, Radar would prove to be a powerful instrument in the hands of research workers. Investigations which could not be taken up up-to-date would now be carried out easily. A few months ago, as a result of U.S. Army radar experiments during which radio-waves were recorded to have reflected back from the Moon (situated about 238,000 miles from the Earth), it was thought that topographical mapping of the planets, determination of their composition, communication with them and rocket trips to them would be taken up in near future. Almost simultaneously the Australian Radio physicists associated with the Council of Scientific and Industrial Research of that country, announced their having established Radar contact with the Sun.

(*h*) *State of Knowledge of Radio-Wave Propagation.*—In 1925, Appleton and Barnet as well as Smithrose and Barfield in England, and Breit and Tuve in U.S.A., gave an experimental proof of the existence of an atmospheric ionized layer from 90 to 125 km above the earth (as obtained in temperate countries) called "Kennelly-Heaviside Layer" (main E or E_1 region). Later on in 1927, Appleton discovered an upper ionized region from 240 to 350 Kms above the earth called "Appleton Layer" (main F or F_2 region). The "magneto-ionic theory'" given by Appleton and Hartree was experimentally corroborated. Considerable amount of valuable work was done in most of the countries on the equivalent height, maximum equivalent ionic density, ionic gradient, collision frequency, nature of charged particles and ionising agency relating to the different layers. The nature of propagation of long, medium, short and ultra-short and micro-waves was fully investigated. The existence of an ionized layer between "E" and Ozone layers—"D Layer"—specially during the day-light hours, was discovered in 1928 by Appleton. Experiments during this period also indicated existence of ionized regions in troposphere and lower stratosphere, called "C layers". The effect of 11-year sunspot cycle on the propagation of short and longer waves was studied. Valuable contributions were made during the period on (1) Reflection of radio-waves from the ground, (2) field strength measurements, (3) fading and fading control, (4) polarization of signals and (5) atmospherics (including their wave-forms, their direction of arrival, their number/minute and their intensity on various wave-lengths).

IV. Conclusion

No science or technology has ever made such a phenomenal advancement within half a century as this Radio. Even its different branches have become vastly speciailised subjects. From its modest beginnings in laboratory, it got firmly transplanted into the life of man. Radio is now indispensable to the nation both during peace and war. It is hoped that in future full-fledged Institutes (to be called Radio Institutes) solely devoted to advanced instruction, research and development in different branches of Radio will be established instead of allotting a single Department to this very important subject in a science or engineering institute.

Note.—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.—*Ed.*

ENGINEERING RESEARCH IN HYDERABAD STATE

AN outstanding event marking a new era in the history of engineering progress in Hyderabad was the gracious *Firman-e-Mubarik* of His Exalted Highness the Nizam giving his Royal assent to the establishment of an Engineering Research Department in the State.

In inaugurating the new Department, the Nawab Sahib of Chattari, the then President of H.E.H. the Nizam's Executive Council, declared:—

> "... India is a poor country and any conception, however beautiful and good it may be, is of no value if it is beyond the financial means of the country and, therefore, it is for the engineers to find out how to make things cheaper, so that we may be able to give the benefit of good houses, bridges, communications, etc., to the poor. Your Research Department will be, I hope, one of the blessings of the Osmania regime, which will remain in the history of Deccan as one of the brightest periods for progress and improvements."

The full scheme of the Engineering Research Laboratories is contemplated to be worked out in such a way that the whole plan may be progressively developed in yearly stages as a Five-Year Plan. For the preparation and the execution of this plan, the Government has appointed Dr. S. P. Raju as the Director. He will in addition to this be responsible for initiating, organizing, co-ordinating and directing engineering research in the Hyderabad State. The scope of the Department will include problems connected with all branches of engineering like (1) Irrigation, (2) Soil Mechanics, (3) Building Materials, (4) Building and Housing Research, (5) Roads, (6) Public Health Engineering and (7) Hydraulic Machinery.

After careful consideration it has been decided to locate the permanent laboratories below Himayatsagar which is one of the two reservoirs constructed as a flood preventive measure after the disastrous flood of 1908. The site extending over an area of about 500 acres of land is at the commencement of the Irsalgandi Channel which carries the supply of drinking water to the southern portion of Hyderabad City. The site ensures an adequate and continuous supply of water for large-scale hydraulic experiments and provides a quiet and congenial atmosphere for research with sufficient scope for future expansion.

To make the station a self-contained unit, it is planned to construct not only laboratories, library, etc., but also quarters for the staff with all civic and social amenities and a guest house for visitors.

At the suggestion of the Director, it has been decided that while arrangements are in progress for the development of the Himayatsagar site, research work may be undertaken in temporary sheds erected in the grounds of the Red Hills Water Reservoir. Various problems received from the different branches of the P.W.D. and the Local Fund Department are already under investigation in the different laboratories.

The initial plan includes :—

(1) Expenditure of Rs. 3½ lacs for the acquisition of 500 acres of land under Himayatsagar and the partial development of permanent laboratories and staff quarters;

(2) Expenditure of about Rs. 3,20,000 for sheds, equipment, etc., for starting research work in temporary laboratories;

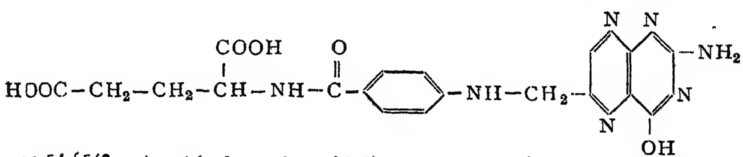
(3) Establishment of a field research station in Nizamabad, for investigation of engineering problems connected with Nizamsagar development at a cost of Rs. 67,000; and

(4) Reservation of Rs. 20,000 for the training of research personnel.

SYNTHESIS OF FOLIC ACID

LAST year Angier *et al.*[1] announced the synthesis of a compound showing physical and biological properties identical with those of the *L. Casei* factor (folic acid) isolated from the liver. The synthetic product, when administered orally or parenterally in daily doses of 5-15 mg., proved effective in sprue,[2] Addisonian pernicious anæmia,[3] macrocytic anæmia of pellagra, sprue, pregnancy or of nutritional origin,[4] megaloblastic anæmia of infancy[5] and chronic diarrhœa.[6]

In view of the dramatic results reported on the hæmopoietic activity of folic acid, further details of the chemical constitution and synthesis of folic acid were anxiously awaited. A recent communication by the same group of 16 authors[7*] hailing from the Lederle Laboratories and Calco division of the American Cyanamid Company discloses particulars of the degradation reactions used to characterise the liver *L. Casei* factor, based on which the following structure was postulated :—



N-[4-{[(2-amino-4 hydroxy-6 pteridyl) methyl] amino} benzoyl] glutamic acid

Proof of the above structure was afforded by two methods of synthesis. The first method of synthesis consisted of reacting equimolecular amounts of 2, 4, 5-triamino-6-hydroxy-pyridine, *p*-aminobenzoyl-1(+)-glutamic acid, and 2-3-dibromopropionaldehyde in the presence of an acetic buffer.

The second method of synthesis was carried out by reacting 2, 3-dibromopropionaldehyde with pyridine and condensing the product with 2, 4, 5-triamino-6-hydroxy pyrimidine and potassium iodide and reacting the resulting product with *p-aminobenzoyl*-1(+)-glutamic acid and sodium methoxide in ethylene glycol at 140° C.

In either method, the crude product containing about 15 per cent. of the biologically active material was purified by removing impurities precipitable by barium, extractable by butanol and adsorbed by charcoal and finally crystallizing the active material at pH 3·0. The name pteroylglutamic acid has been suggested for this compound.

This synthesis marks the culmination of active research work on different lines, *viz.*, the elucidation of the chemical nature of the anti-pernicious anæmia factor of liver, the *L. Casei* factor and vitamin Bc, the anti-chick-anæmia factor, etc., and opens up a new chapter in the study of hæmopoietic substances. Although the synthetic folic acid has proved very effective in the treatment of macrocytic anæmias, it is interesting to note that the highly concentrated liver extracts of proved activity (15 U.S.P. units per c.c.), when tested microbiologically and on chicks, was found to contain hardly 1·0 $\mu g.$ of free folic acid per c.c. even after treatment with vitamin Bc conjugase.[8] Perhaps the antipernicious anæmia factor is a compound closely related to folic acid. Future research is expected to throw more light on this aspect and on the nature of the "intrinsic" and "extrinsic" factors.

G. B. R. SARMA.

* R. B. Angier, J. H. Boothe, B. L. Hutchings, B. L. H. Mowat, J. Semb, E. L. R. Stokstad, Y. Subbarow, C. W. Waller, D. B. Cosulich, M. J. Fahrenbach, M. E. Hultquist, E. Kuh, E. H. Northey, D. R. Seeger, J. P. Sickels and J. M. Smith, Jr.

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SLEEP AS AN ADAPTATION PHENOMENON

BY

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EXPERIMENTS on unstriated muscle have shown that activity is accompanied by concomitant inhibition, known as adaptation or accommodation, the extent of which varies. If this inhibition equals or exceeds the excitation process which produces it, then the tissue may be said to be in inhibition or asleep. Adaptation to this inhibition or adaptation[1,2] would result in awakening of the tissue, and the cycle would then be repeated.

Pavlov has described sleep as a kind of internal inhibition. Kleitman and others[3] confess some difficulty in understanding what constitutes the inhibitory impulse concerned in going to sleep naturally, where it arises and how inhibition is abolished previous to akawening. These difficulties can be explained as above if sleep is considered to be an adaptation phenomenon.

The depth of sleep may be measured in a number of ways.[4] It is found that there are wide individual variations, but often sleep increases in depth until two or three hours after the onset of sleep, it reaches its maximum. After this it decreases until six hours after the onset of sleep, and then stays approximately uniform. Just before the time to wake up is reached, it becomes very light. This curve of intensity of sleep is very similar to the curve of adaptation in unstriated muscle (Fig. 1).

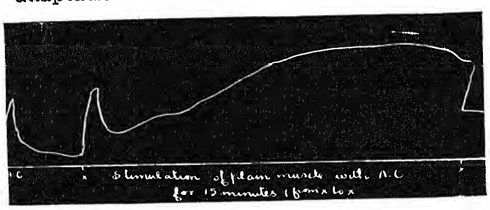

FIG. 1. *Mytilus* muscle. 1st contraction represents one following stimulation with alternating current (A. C.) 10 volts for 10 sec. The second with A.C., 10 volts for 10 minutes.

Just as the variations in sleep in individuals are many, so also the curve of adaptation in unstriated muscle to alternating current varies greatly in different muscles. This similarity suggests that sleep is an adaptation phenomenon, brought about by previous activity, and probably due to accumulation of calcium in some parts of the nervous system. The onset of sleep would then be due to adaptation and awakening, adaptation to adaptation. On this view, practically most of the phenomena connected with sleep can be explained.

The sleep of the infant.—The continuous sleep of the infant may be said to be due to rapidity of adaptation, and slow adaptation to this adaptation, as happens in some *Mytilus* and frog stomach muscles (Fig. 2). It appears that as age advances, this adaptation to the original stimulus becomes less; and adaptation to adaptation more rapid, as is found in some unstriated muscles.

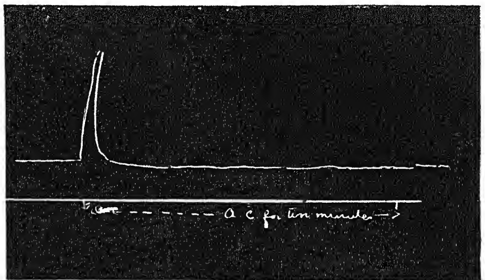

FIG. 2. *Mytilus* muscle. Stimulation with A.C. for 10 minutes.

The problem of sleep has been approached[5] from the viewpoint that sleep is the basal state and wakefulness is a superimposed condition. This may be likened to an analogous state in some unstriated muscles, when the residual or threshold adaptation appears to be high, the factor causing adaptation appears to be increased in its free state, and more labile. With ageing these two factors diminish in intensity as happens with unstriated muscles which become more sensitive.

Sleep of the adult.—In sleep of the adult the adaptation to initial adaptation appears to be more rapid. As in adults or children, unstriated muscle may show one or two maxima (Fig. 3) wide variations are shown by adults as well as by unstriated muscle.

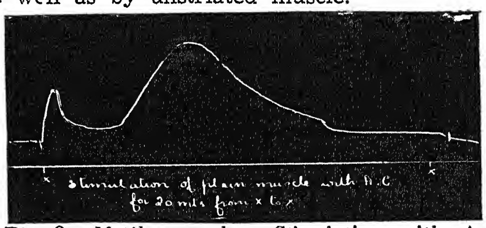

FIG. 3. *Mytilus* muscle. Stimulation with A.C. 10 volts for 20 minutes.

Disturbances of sleep.—Intractable insomnia will be due to lack of adaptation; in some unstriated muscles there is hardly any adaptation (Fig 4). In others there is more adapta-

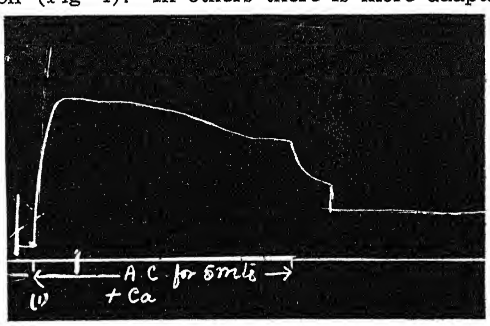

FIG. 4. *Mytilus* muscle. Stimulation with A.C. 10 volts for 5 minutes.

tion but incomplete (Fig. 5). Thus the muscle reproduces those phenomena which are similar

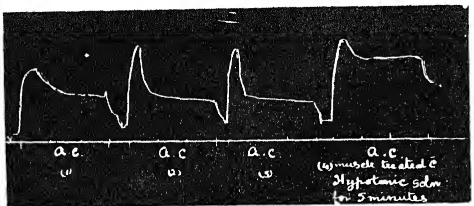

FIG. 5. *Mytilus* muscle. Stimulation with A.C. 10 volts for 3 minutes each.

to those of sleep of varying intensity. In some individuals sleep is disturbed often during the night; such a condition in muscle is shown in Fig. 6. This curve will also represent sleep

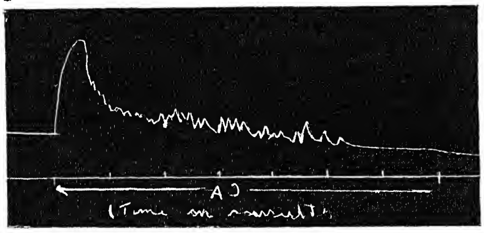

FIG. 6. *Mytilus* muscle. Stimulation with A.C. 10 volts.

with dreams. In some individuals sleep may be deep of short duration. This will be due to rapidity of adaptation to initial adaptation, as may be found in unstriated muscle.

Evidence that sleep is due to adaptation.—If sleep is due to adaptation, then it will be the result of activity. It is common knowledge that one desires to sleep if one is tired, in unstriated muscle, fatigue and adaptation are the same.[6,7] The great inclination to go to sleep as a result of excessive use of the eyes, the auditory apparatus or muscles is thus accounted for on this hypothesis.

The effect of activity is also shown by the following experiment. Three students did not sleep one night. The next day they could keep awake without much difficulty, but if they attended a lecture on nervous system, and paid attention to it, they fell asleep.

An interesting fact is that in unstriated muscle subliminal stimulation produces inhibition when greater stimulation excites the muscle;[6] this is due to the fact that adaptation accompanying the excitation exceeds the latter, thus causing inhibition insted of contraction. The same appears to apply to sleep. Thus an infant may be put to sleep by rocking, patting or mild stroking of the back; travelling in a vehicle produces sleep. Lullabies act in a similar way. Even adults fall asleep in a running train; monotonous stimuli thus induce sleep; these stimuli if excessive will produce the opposite result. Procedures preparatory to routine sleep in one's life reduce excessive stimulation; thus it is found in unstriated muscle, that if the stimulation is excessive then inhibition or adaptation process is overcome (Fig. 7). Adaptation may not be equal in all

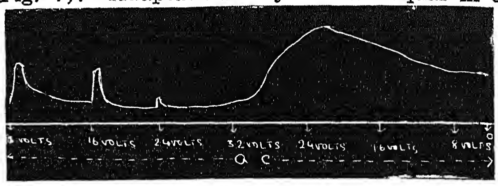

FIG. 7. *Mytilus* muscle. Stimulation with A.C.

parts of the cortex, thus accounting for sleepwalking, dreams, persistence of the sense of time during sleep, sensibility of the mother to the voice and movements of the child.

The injection of dilute calcium chloride into the third ventricle has been found by Demole to produce sleep. So it is possible that sleep is due to local accumulation or liberation of calcium in some part of the nervous system. There is a fall of the blood calcium in normal sleep and in that produced by sedatives and hypnotism.[7] This may be due to its withdrawl by the nervous system.

Adaptation may be effected by chemicals and from impulses from other parts of the brain, such as a "sleep centre". The effect of raw hen's eggs on one kind of insomnia[8] suggests that chemicals may effect this adaptation.

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RADIO-ISOTOPES FROM ATOMIC PILES

THE cyclotron was a useful source of radioisotopes and put at the disposal of research workers in medicine, biology and chemistry a supply of "tagged" or "labelled" atoms—atoms that can be traced and counted by convenient physical means. But in this field the cyclotron is now eclipsed by the atomic pile that was devised in connection with the atomic bomb programme. The uranium chain-reacting pile is far more efficient for synthesising these isotopes which for the first time are becoming available in really large quantities. Whereas a millionth of a gram of a radio-isotope used to be something to talk about, radio-isotopes are now being prepared by means of the atomic pile in grams and, in some cases, kilograms. A month ago it was announced by the U.S. War Department that one hundred isotopes were coming into large-scale production and would be made available to hospitals, industrial and university research laboratories, and medical research institutions.

—(*Discovery*, August 1946, p. 227).

A CASE OF PERSISTENCE OF THE LEFT SYSTEMIC ARCH IN A WEAVER BIRD, *PLOCEUS PHILIPPINUS PHILIPPINUS* (LINNÉ)*

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INTRODUCTION

RECORDED cases of arterial abnormalities in birds are few. The majority of these abnormalities represent persistent embryonic vessels. Mackay (1888) recorded ligamentum botalli (arteriosum) and a ligamentous vestige of the left systemic arch in some species of birds. Hochstetter (1890) cited two cases of obliterated ductus arteriosus on one side in *Aquila nœvia* and *Circus cineraceus*. Finn (1891) recorded the presence of right ductus caroticus (misnamed ductus botalli by him) in *Nycticorax violaceus* and *Dafila spinicauda*. Beddard (1898) mentioned the presence of a lumen in the vestige of the left systemic arch in *Spizœtus* and *Aceros*. Bhaduri (1939) described the persistence of the right ductus caroticus in the pigeon *Columba livia intermedia*. Glenny (1939, 1940) recorded the presence of a functional left systemic arch in *Ceryle alcyon*. He also recorded the occurrence of the right ductus caroticus in *Zenaidura macroura carolinensis* (1940 *a*) and in *Dryobates v. villosus* (1943), and of the right ligamentum caroticum in *Loxipasser anoxantha* and *Loxigilla violacea affinis* (1942). He further described the presence of a short lumen in the distal part of the vestige of the left systemic arch while its anterior portion persisted as ligamentum aortæ in four species of Trogoniformes (1943 *a*). Recently two more cases of persistence of the right ductus caroticus in the pigeon are reported by Subhapradha (1944) and Mathew (1944). Glenny (1940-45), and Bhaduri and Biswas (1945) have shown that the ligamentum botalli of the right or left or both sides are present in a large majority of adult birds.

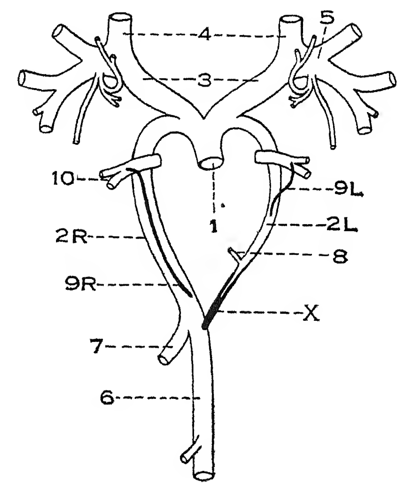
In the course of my studies on the cervical and thoracic arteries of birds I recently came across an interesting case of the persistence of the left systemic arch in a weaver bird, *Ploceus p. philippinus* (Linné). So far as I am aware no fully developed left systemic arch has been recorded from any adult avian species.

In this connection I should like to express my indebtedness to Dr. M. L. Roonwal, M.SC., PH.D. (Cantab.), F.N.I., Assistant Superintendent, Zoological Survey of India, and to Prof. J. L. Bhaduri, of the Zoology Department, Calcutta University, for some helpful suggestions in the preparation of this article.

DESCRIPTION

The specimen was an adult female, and was, as far as could be seen, normal in all respects, except in the possession of a left systemic arch (Text-Fig. 1), which normally persists in a more or less obliterated condition in adult birds. The arterial system of the specimen was injected in the usual way.

The systemic arches (2) arise from a common root (1), and each sends the corresponding innominate artery (3), which as usual divides into the common carotid (4) and the



TEXT-FIG. 1. Main arteries in the region of the heart of the abnormal specimen of *Ploceus p. philippinus* (ventral view).

subclavian (5). The right systemic arch (2R) curves over the right bronchus towards the dorsal bodywall, whence it passes backward to form the dorsal aorta (6), which at once gives rise to the cœlic artery (1). The course of the left systemic arch (2L) is similar to the right one. It is, however, narrower than the right arch and gradually thins out into a solid strand (X) at the distal end where it joins the dorsal aorta. There is a lumen in the left systemic arch as is proved by the presence of the injection mass in it. The lumen gradually diminishes, becomes extremely fine, and is closed distally from where the arch is ligamentous. A small vessel (8) is seen to be given off from this arch near the distal end of the lumen. It is a very fine vessel and could be traced upto the pleura of the left lung.

A ligamentum botalli (9) is found on each side connecting the pulmonary (10) with the systemic arch.

DISCUSSION

Ligamentous vestige of the distal part of the left systemic arches are common in birds, as shown by Mackay (1888),† Beddard (1898), Glenny (1940-45), and Bhaduri and Biswas (1945, and unpublished observations). Mackay

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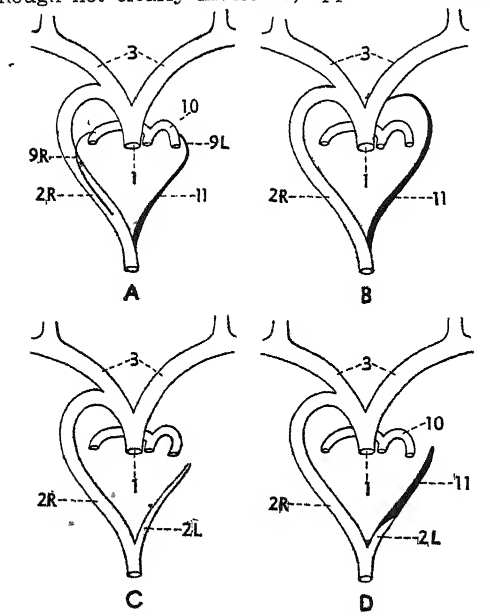
†He described the ligamentous vestige of the left systemic arch together with the left ligamentum botalli as ductus botalli.

(1888) also described ligamentous vestige of the whole of the left systemic arch in some birds from his own as well as from Professor Macalister's observations.

Glenny's (1939, 1940) description of the persistent left systemic arch in the kingfisher *Ceryle alcyon* shows that its distal part is an open vessel, while its proximal part, *i.e.*, the portion between the aortic root and the pulmonary arch is absent, and there is no ligamentum botalli. In *Temnotrogon reseigaster*, *Curucujus massena*, *Trogon melanocephalus* and *Trogon strigilatus*, according to Glenny (1943 *a*), the distal portion of the left aortic arch presents a short lumen while the anterior portion persists as a ligament. Beddard's (1898) instances of *Spizœtus* and *Aceros*, though not clearly indicated, appear to be more

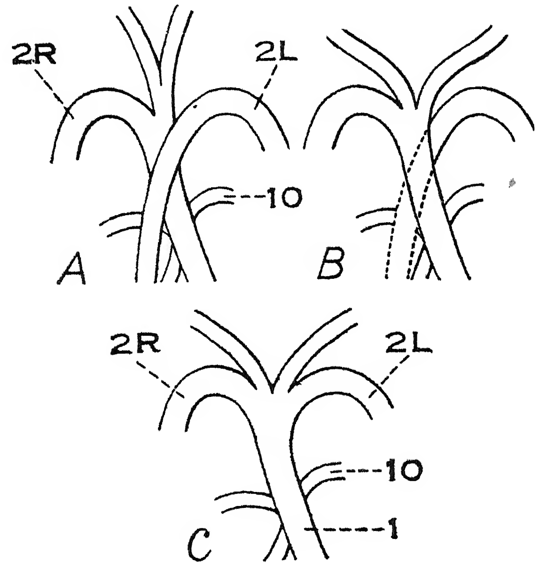


TEXT-FIG. 2. Comparative diagrams of persistence of the left systemic arch in adult birds. A–Most prevalent type (after Glenny, and Bhaduri and Biswas); B–Condition in some *Raptores* and *Gulls* (after Mackay); C–Condition in *Ceryle* (after Glenny); D–Condition in *Spizœtus*, *Aceros* and some Trogoniformes (after Beddard, and Glenny).

or less similar to those of the above species of Trogoniformes. A comparison of the recorded cases of the persistence of the left systemic arch. This condition would indicate that obliteration of this arch in this specimen probably started from the distal end; but in the cases cited by Beddard and Glenny obliteration seems to have started from the proximal ends.

The general plan of the arterial arches in this specimen of *Ploceus* is very similar to that of middle and late embryonic periods in birds as figured by Glenny (1943 *b*). It approaches a reptilian condition—especially that of *Emys* (Hafferl, 1933), but in the present case there is no separate root for the left systemic arch. A probable explanation may be as follows.

It is well known that in the reptiles both the systemic arches have separate roots. If the fourth left (aortic) arch is obliterated we get the condition generally found in birds. From the disposition of the systemic arches in the specimen of *Ploceus* described above it appears that the root of the left systemic arch has disappeared earlier so that the original root of the right arch comes to serve for the origin of both the systemic arches (Text-Fig. 3).



TEXT-FIG. 3. Schematic representation of the probable mode of transformation of the systemic arches from the reptilian to the condition observed in *Ploceus*. A Condition in reptiles; B–Hypothetical intermediate stage; C–Condition in the present instance of *Ploceus*.

Key to the numberings in Text-Figs. 1-3
R = Right ; L = Left.

1. Aortic root.
2. Systemic arch.
3. Innominate artery.
4. Common carotid artery.
5. Subclavian artery.
6. Dorsal aorta.
7. Cœliac artery.
8. A small vessel from the left systemic arch.
9. Ligamentum botalli.
10. Pulmonary artery.
11. Ligamentous vestige of the left systemic arch.

X. Ligamentous distal end of the left systemic arch.

arch in adult birds (Text-Fig. 2) reveals that the case of *Ploceus* here presented is unique in that it is the distal and not the proximal end which is ligamentous in the left systemic

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WHALE MEAT FOR HUMAN CONSUMPTION

THE Department of Scientific and Industrial Research is sending a team to the Antarctic to make a scientific study of the possibilities of using lean whale meat for human food. The problems of selection, transport, storage and distribution of the meat will be investigated.

The scientists sail for the Antarctic this month in the whaling factory ship "*Balaena*". The expedition has been made possible by the collaboration of Messrs. United Whalers, who have generously provided a scientific laboratory and facilities for the investigation on board this new ship.

In the years before the war the world production of whale oil averaged about 500,000 tons a year, although there was considerable yearly fluctuation. In the production of this oil about 600,000 tons of lean whale meat was handled by the British and Norwegian whaling fleets. Some of this was de-hydrated and converted into animal feeding stuffs and fertilisers, but the rest was thrown back into the sea after the extraction of the oil. 600,000 tons of meat is something like half the pre-war import of meat into this country, but previous scientific enquiries have shown that only a proportion of this amount of whale meat can be suitable for human food.

The whale, besides providing an important supply of animal fat, in the form of whale oil, represents a potentially large supply of animal protein, which is untapped for food uses. A study of the possibilities and problems connected with the utilisation of whale meat is clearly of considerable practical importance at the present time. It is against this background that the Department of Scientific and Industrial Research has planned to send this expedition to the Antarctic. The results of the investigation will be followed with interest by the Ministry of Food, with whom the D.S.I.R. is co-operating closely.

This will be the second occasion that the D.S.I.R. has sent an expedition to the Antarctic. In 1939-40 the Department sent out a small team under the leadership of Lieut-Commander Marr, who has much previous experience of whales and whaling in connection with the investigations of the Discovery Committee. The results of that earlier expedition confirmed, what whaling personnel have always claimed, that the meat of the whale is perfectly wholesome. Fresh whale meat can be very good to eat scarcely distinguishable from beef.

Like other meats, the quality and properties of whale-meat vary in different parts of the animal; they also vary according to age and sex and in the different types of whale (Blue, Fin, Humpback and Sei). The general question as to how to make the best use of the lean meat of the whale can only be answered when more is known about the variability in the properties of the meat and about the basis upon which the meat could be selected for different food uses. There is no doubt that some proportion of the total would form a good and attractive meat if the problems of selection, transport, storage and distribution could be solved; and there is little doubt that types of whale meat which might be unsatisfactory for use as fresh meat, could be used for making highly nutritious and palatable processed foods.

The research team which is being sent out to the Antarctic this coming season will make a detailed study of the catch of the whaling factory ship "*Balaena*". Records will be kept of the size, species and various characteristics of the individual whales as they come aboard. The team will test the meat for palatability and carry out systematic studies in the laboratory on board in order to relate palatability to such characteristics as colour, acidity and nitrogenous extractives, which are the main constituents of meat extract, especially important for flavour. Separate records kept by an Inspector of the Ministry of Agriculture and Fisheries and by a biologist, who is being sent out by the Discovery Committee, will ensure complete documentation of the catch of this particular factory ship which may amount to perhaps 1,500 whales. It is hoped that the information obtained, in conjunction with the data collected by inspectors of other vessels, may make it possible to give a fairly accurate estimate of the characteristics of the lean meat of the present population of whales in the Antarctic.

The expedition will be led by Dr. R. A. M. Case, who has been lent to the Department of Scientific and Industrial Research by the Royal Navy Physiological Laboratory, where he has been studying the effects of high temperature, humidity and pressure on submarine crews. Dr. Case will naturally be interested in the general physiology of the whale and the bodily mechanisms which enable this curious mammal to lead a submarine existence. This subject is by no means unconnected with the qualities of whale meat as a food, because the character and composition of the muscles of the whales are adapted in several striking respects to the requirements of its under-water existence. There are indications from work carried out with material from earlier expeditions that, as an indirect consequence of this submarine adaptation, the proteins of whale meat are of exceptional value for growth in comparison with the meat proteins of land animals.

LETTERS TO THE EDITOR

INTERFERENCE BY CERTAIN SUBSTANCES IN THE ESTIMATION OF THIAMINE BY THE THIOCHROME METHOD

THE chemical methods employed for the estimation of thiamine fall into two groups: (1) the colorimetric method and (2) the thiochrome method. A variety of substances have been shown to interfere in the colorimetric estimation of thiamine [Prebluda and McCollum (1939); Melnick and Field (1939); Emmet, Peacock and Brown (1940); Kirch and Bergeim (1942) and Sealock and Goodland (1944)]. A systematic study of this interference by certain substances in the colour development with diazotised *p*-aminoacetophenone has been recently carried out by Sealock and Goodland (*loc. cit.*). They found that the presence of heavy metal salts, potassium ferricyanide, hydroxyl amine, hydrogen sulphide, cysteine, iodine and sodium sulphite markedly influenced the reactivity of thiamine with the diazotised *p*-aminoacetophenone reagent, thereby giving low values for thiamine. Such a study, however, has not been carried out with the other chemical method, namely, the thiochrome method, employed for the estimation of thiamine. Thus, it was felt to be of interest to undertake this investigation, which was also of practical value, since the thiochrome method is being used in our laboratories for the routine assays of thiamine in foodstuffs and other biological materials.

The various substances under test were dissolved in water and such aliquots were added to the reaction mixture, so as to attain the final concentrations of the interfering substances ranging from 10^{-2}M to 10^{-5}M. The reaction mixture consisted of 10 ml. of the test solutions + 8 ml. of M/10 phosphate buffer pH 7·4 and 1 ml. of thiamine solution containing 100 μg; the final volume of the reaction mixture was adjusted to 20 ml. and it was incubated at 37° C. One aliquot was pipetted out as soon as thiamine was added to the reaction mixture and another after 90 minutes. The amount of the vitamin remaining in these two aliquots was estimated according to Bhagvat's (1943) method. A parallel incubation was carried out with 100 μg thiamine + phosphate buffer pH 7·4. This served as a control. Following substances were tested:

(1) Mercuric chloride; (2) Silver nitrate; (3) Sodium tungstate; (4) Potassium ferricyanide; (5) Stannous chloride; (6) Ferric chloride; (7) Sodium nitrate; (8) Barium chloride; (9) Zinc sulphate; (10) Arsenious acid; (11) Iodine; (12) Sodium pyrophosphate; (13) Potassium oxalate; (14) Lead nitrate; (15) Sodium hydrosulphite; (16) Cysteine; (17) Potassium permanganate; (18) Sodium sulphite; (19) Hydrogen sulphide; (20) Glutathione; (21) Potassium iodide; (22) Sodium nitrite; (23) Calcium chloride; (24) Potassium perchlorate; (25) Barium nitrite; (26) Bromine; (27) Manganese dioxide; (28) Potassium iodate; (29) Formaldehyde; (30) Acetaldehyde; (31) Hydroxyl amine.

Out of 31 substances tested, only 9 were found to interfere with the thiochrome test. Low recovery of the added thiamine was obtained in the presence of these 9 substances, of which, mercuric chloride, silver nitrate, potassium permanganate, iodine and bromine, produced the greatest effect; hydroxyl amine, sodium sulphite, hydrogen sulphide and sodium

pyrophosphate were somewhat less effective in the concentrations used. Further, the interference encountered by these substances was found to increase on incubation. Substances such as sodium tungstate, potassium ferricyanide and cysteine, which were shown by Sealock and Goodland (*loc. cit.*) to affect markedly the thiamine values obtained by the colorimetric procedure, were found to be ineffective when the thiochrome method was employed for the assay of thiamine.

Next, an experiment was planned to find out if the interference encountered was a function of the relative concentrations of the interfering compound and thiamine. The results illustrated in Table I show that it was so.

TABLE I

Percentage recovery of added thiamine at different concentrations of the interfering substances

Reaction mixture: 8 ml. M/10 Phosphate buffer (pH 7·4) + 1 ml. thiamine solution. (100 μg) + 10 ml. solution of the interfering substance. Final volume 20 ml.

Substance	Final concentration of the substance	Percentage recovery of added thiamine	
		0 minute	90 minutes
Mercuric chloride	5×10^{-4} M	46·4	4·5
	5×10^{-5} M	82·2	12·5
	1×10^{-6} M	100·0	100·0
Silver nitrate	5×10^{-3} M	14·3	0·0
	1×10^{-3} M	27·3	0·0
	5×10^{-4} M	33·0	18·8
	1×10^{-4} M	36·0	36·0
	1×10^{-5} M	86·4	—
Iodine	1×10^{-2} M	—	9·1
	1×10^{-3} M	6·7	7·1
	1×10^{-4} M	100·0	21·4
Sodium pyrophosphate	1×10^{-2} M	63·3	28·8
	1×10^{-3} M	100·0	100·0
Potassium permanganate	1×10^{-2} M	9·4	3·4
	1×10^{-3} M	70·4	4·5
	1×10^{-4} M	96·3	4·5
	1×10^{-5} M	100·0	100·0
Bromine	1×10^{-2} M	15·4	0·0
	1×10^{-3} M	68·2	0·0
	1×10^{-4} M	90·9	9·5
	1×10^{-5} M	90·9	16·7
	1×10^{-6} M	100·0	85·7

The influence of the pH of the reaction mixture on the extent of the interference exerted by the different substances was studied next. Thiamine solution was incubated in presence of the interfering substances at different pHs, (Acetate buffer was used to obtain pH from 4 to 5·6 and phosphate buffer to obtain pH 7·4) and the amount of thiamine left over was estimated (Table II).

TABLE II

Effect of pH on the percentage recovery of added thiamine in presence of:

Reaction mixture: 8 ml. of M/10 buffer + 1 ml. thiamine (100 μg) + 10 ml. of solution of the interfering substance. Final volume 20 ml.

Substance	Concentration of the substance	pH	Percentage recovery of added thiamine	
			0 minute	90 minutes
Mercuric chloride	1×10^{-4}	5	—	6·0
	,,	5·6	—	6·4
	,,	7·4	46·4	4·5
Silver nitrate	1×10^{-3}	4	25·0	14·3
	,,	5	25·0	14·3
	,,	5·6	21·4	14·3
	,,	7·4	27·3	0·0
Iodine	1×10^{-3}	4·0	18·2	12·5
	,,	5·0	18·2	8·3
	,,	5·6	13·6	8·3
	,,	7·4	6·7	7·1
Potassium permanganate	1×10^{-3}	4·0	72·7	12·5
	,,	5·0	81·7	8·3
	,,	5·6	81·7	8·3
	,,	7·4	88·2	0·0

The interference encountered in the presence of different substances tested above is not dependent on the pH of the reaction mixture.

The results presented in this paper and those reported by Sealock and Goodland (*loc. cit.*) definitely show the limitations of the two chemical methods used for the estimation of thiamine. The thiochrome method appears to yield better results than the colorimetric procedure, since fewer substances are found to interfere with the thiochrome reaction. The interference encountered with mercuric chloride and silver nitrate is probably due to the precipitation of thiamine by these compounds, that with iodine, due to the formation and precipitation of a resinous addition product and with potassium permanganate and bromine, due to oxidation of the thiamine molecule. The substances mentioned above are seldom encountered in thiamine-containing materials, but the possibility of similar difficulties being present could not be overlooked. Bhagvat and Devi (1944) have shown the presence of a thermostable factor in foodstuffs, which rapidly inactivated thiamine *in vitro*. This factor was found to retain part of its activity towards thiamine even on ashing.* Whether this was due to the presence in the ash, of substances of a similar nature as mentioned in this paper, is difficult to say. It is hoped that these results might prove of value in elucidating the nature of the antithiamine principle of foodstuffs.

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Nutrition Research Labs.,
Indian Research Fund Association,
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October 31, 1946.

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* Bhagvat, K., and Devi, P., Unpublished work.

A MODIFICATION OF RAMON'S FLOCCULATION METHOD

RAMON (1922) by introducing the flocculation test, made the titration of Diphtheria Antitoxin a simple procedure. In this reaction the first tube to flocculate represents the tube where the antigen and antibody is just neutralized. It would have been the ideal method for assay of Diphtheria Toxin and Antitoxin, but as Glenny (1925) and other workers have pointed out, the results obtained by the *in vitro* method have not always agreed with the results obtained by the intracutaneous test method of Romer. The discrepancy may be due to the fact that in the *in vitro* method the first tube to flocculate may not be the tube where exactly the equivalent quantities of toxin and antitoxins are neutralized. In order to improve this test, we introduced certain agents which enhance the specific combination of toxin and antitoxin and also the flocculation reaction. After a great deal of search, it was found that a colloidal emulsion of Tolu Balsam which had been stabilized with cardiolipins served the purpose best.

In this modified method, small quantities of the above emulsion were added to the series of tubes containing the toxin and antitoxin. The toxin-antitoxin mixture which flocculated first in such series showed a neutralisation value which agreed well with that obtained by Römer's method. The size of floccules was definitely large and easy to detect, and in most cases the time of flocculation was hastened.

Detection of flocculation can further be facilitated by the addition of India ink.

Details of the experiments will be published soon.

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Haffkine Institute,
Bombay,
October 18, 1946.

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BACTERIOLOGICAL GRADING OF INDIAN MILKS

MILK is particularly susceptible to microbial infection and spoilage during all stages of its production, processing, transport and distribution; the strictest bacteriological control is, therefore, essential at every step not only to prevent serious economic and nutritional losses due to its spoilage but also to safeguard the health of the people. Such controls, based on scientific methods of testing and grading milk, are further helpful in preventing the inclusion of unsatisfactory supplies in bulked milk at collecting centres and providing information for price differentiation according to quality as a means of inducing the producers as well as distributors to maintain the highest standard of cleanliness in their methods of production. By a proper co-ordination of the various activities involved in the production and marketing of milk under centralised control and by an official enforcement of adequate standards of hygiene at all stages of milk handling, countries like England, Denmark and U.S.A., have succeeded in building up permanently a satisfactory milk supply for their people. The importance of introducing similar measures in India for improving and developing the national milk position is being increasingly realised. As a major step in this direction it is necessary to find out a simple, rapid and reliable method of testing milk and evolve suitable standards of quality for grading it. The most widely used methods in other countries for the purpose are the direct microscopic count, plate count, presumptive coliform test, methylene blue reduction test and resazurin test. Of these, the last one has recently come into great prominence as a very useful and discriminative method for assessing the hygienic quality of milk.

Both methylene blue and resazurin tests measure the rate at which reducing systems are produced by growing bacteria in milk. The latter is, however, more sensitive to the weak static reducing systems of leucocytes and other cells present in the milk at the actual time of the test and is thus responsive to high cell counts, which are frequently caused by mastitis.[1,2,3,4] The test is, therefore, of value in detecting abnormal milks (colostral, late lactation and mastitis milks) which are considered unsuitable for manufacturing cheese, butter and other milk products. The most important advantages of the resazurin test are, however, its rapidity and flexibility. The dye is reduced in two stages as a result of bacterial and cellular activity, first from resazurin (blue) to resorufin (pink) passing through various intermediate shades of purple, and then to dihydroresorufin (colourless). The first stage is irreversible and the second one reversible as in the case of methylene blue.[3] The test is carried out either by noting the colour change brought about after a definite period of incubation or by recording the time required for reduction to any particular colour shade or the final colourless form. Accordingly the results can be obtained in a much shorter time than in the case of methylene blue test and milks can be classified into two or more grades on the basis of the rates of resazurin reduction to different colour shades. A one-hour resazurin test[1,2] in which the milk is graded according to the colour change shown by resazurin at the end of one hour's incubation at 37° C. has been recommended for general milk testing and advisory purposes and some modifications of the same, suited for local conditions, have been adopted in England provisionally for official control purposes.

The introduction of the one-hour resazurin test for the routine testing and grading of milk

in India is expected to prove of great value in solving the national problem of organising and improving the milk supply position. Accordingly, the utility and applicability of this method for testing different kinds of milk marketed in India, *viz.*, cow, buffalo and mixed milks, drawn from various sources reflecting the usual conditions of milk production and handling, have been critically examined at this laboratory. More than a thousand samples obtained in different seasons have been subjected to the one-hour resazurin test as well as plate count, methylene blue reduction test and occasionally microscopic examination.

For the resazurin test, one ml. of 0·005 per cent. resazurin solution (Eastman Kodak) was added to 10 ml. of milk in sterile test tubes, the tubes were tightly corked with sterile rubber bungs and incubated in a water-bath at $37° \pm 0·5°$ C. for one hour and the colour shade developed at the end of this period was observed.[2,7] The plate counts and methylene blue reduction times were determined simultaneously according to standard techniques.[5,6]

The results of the resazurin test have been compared with the corresponding plate counts and methylene blue reduction times in the following table. For the latter test a reduction time over 4 hours has been taken to indicate a satisfactory quality, which is found to be a suitable standard throughout the year for conditions prevailing particularly in Bangalore and generally in South India.[8]

TABLE I

Percentage distribution of one hour resazurin readings in different grades

(Figures in the table indicate the percentage of samples in each resazurin class classified into different grades by the other two tests.)

One hour resazurin readings	Number of samples	Methylene blue reduction times (Hours)			Plate counts (per ml.)		
		Over 4	2 to 4	Below 2	Below 200,000	200,000 to 1 million	Over 1 million
Blue, lilac and mauve	527	70	30	..	47	46	7
Pink mauve	140	48	52	..	32	51	17
Purple pink	108	39	47	14	34	40	26
Pink	69	3	38	59	..	25	75
Colourless	161	..	2	98	..	2	98

A reasonably good agreement is found between the two reduction tests. Some discrepancies which are indicated, are due to (*a*) the greater sensitiveness of resazurin test to the action of leucocytes present in some of the samples (as revealed by microscopic examination) and (*b*) the closer relation which resazurin reduction has with the initial reducing substances formed in milk.[4] Both these factors are in favour of resazurin test. There is only a general relationship with plate count but all high count samples are detected by the test.[4,9]

On the basis of the above results, the following standards for grading Indian milks according to the one hour resazurin reduction stage appear to be satisfactory.

One hour resazurin reduction	*Grade proposed*
1. Blue, lilac and mauve	Good
2. Pink mauve or purple pink	Average
3. Pink	Poor
4. Colourless	Bad

These standards are more or less in agreement with those suggested by foreign workers except in the case of the intermediate grades to a slight extent.[2,3]

A standard comparator disc showing the different resazurin colour shades, prepared in England with reference to Shorthorn cow's milk (4 per cent. fat), is put on the market by Messrs. Tintometers, Ltd., London. As this is not found to give satisfactory results for Indian milks (particularly buffalo milks) suitable colour standards for the purpose are being prepared. In the meantime it is hoped that the test will be tried out in other laboratories in this country under different climatic and environmental conditions so that comparative data may be obtained for standardising the test with a view to its official recognition and adoption for the grading of Indian milks.

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Imperial Dairy Research Institute,
Bangalore, H. LAXMINARAYANA.
October 2, 1946.

1. Ramsdell, *et al.*, *J. Dairy Sci.*, 1935, **18**, 705. 2. Davis, *Food Manufacture*, 1939, **14**, 196. 3. —, *Ibid.*, 1942, **17**, 308. 4. Thomas, *Welsh J. Agric.*, 1943, **17**, 117. 5. Ministry of Agric. and Fisheries, London, *Bull.* 1934, 46 6. Wilson, *et al.*, *Med. Res. Counc. Spec. Rep.*, *Ser.* 1935 206. 7. Davis, *et al*, *Dairy Industries*, **1943**, **8**, 115. 8. Verma, *et al.*, *Ind. J. Vet. Sci. and Ani. Hus.*, 1944, **14**, 223. 9. Golding and Gorgensen, *J. Milk Tech.*, 1945, **8**, 189.

VITAMIN REQUIREMENTS OF SOME LACTIC MICRO-ORGANISMS

IN a previous communication, the vitamin requirements of some lactic micro-organisms from the National Collection of Type Cultures, India, Indian Institute of Science, Bangalore, were reported. This is a supplement to the previous one. The vitamin requirements of two more of the lactic micro-organisms L.C. 12, N.C.T.C. 2087 and L.C. 9, N.C.T.C. 2084 have now been studied. The experimental details of preparing the media, inocula and the handling of cultures were the same as those described previously; in the present series of studies, however, 2 ml. of the media in small tubes

TABLE I
Ml. of 0·1 N acid produced per 10 ml. of basal medium

Culture	All Vitamin	No vit.	$-B_1$	$-B_2$	Pantothenic acid	$-B_6$	—Niacin	—Biotin	—Pab	Folic acid
L.C. 9 N.C.T.C. 2084	16·0	3·18	15·48	5·2	4·7	15·8	6·50	8·50	15·1	15·8
L.C. 12 N.C.T.C. 2087	16·2	2·11	13·4	4·11	3·94	8·1	2·79	6·71	16·01	16·0

(4 ml. capacity) and a 4 per cent. concentration of sugar were employed. The acid produced after 72-hour incubation at 37° C. was titrated against 0·05 N alkali delivered from a microburette. The results given below are expressed as ml. of 0·1 N acid produced per 10 ml. of basal medium.

The results indicate that the cultures under study do not require thiamine, *p*-aminobenzoic acid and folic acid. L.C. 9 does not require pyridoxin in addition. L.C. 12 shows great promise of lending itself to niacin assays. The non-essentiality of folic acid for these organisms is a gratifying circumstance since it offers the possibility of assaying amino-acids with media without employing the difficultly available folic acid.

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Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
October 8, 1946.

1. Mistry, S. P., and Sreenivasaya, M., *J. Sci. Ind. Res.*, 1945, **4**, 162. 2. —, Gajjar, I. M., and Sreenivasaya, M., *Curr. Sci.*, 1945, **14**, 95.

CHEMICAL COMPONENTS OF THE FLOWERS OF *MORINGA PTERYGOSPERMA*

THE medicinal virtues of the several parts of the plant *Moringa pterygosperma* Gaertn. (N.O. Moringaceæ) have long been known and appreciated in India.[1] The bark was examined by Ghosh, *et al.*[2] and two bases were isolated, the total amounting to 0·1 per cent. One of them which was obtained in the form of the crystalline hydrochloride had only feeble pharmacological activity. The other, designated moringinine, was a light brown liquid having a strong action like that of the sympathomimetic bases.[3] It failed to give crystalline salts.

The flowers are considered to possess stimulant and aphrodisiac properties and are used as a tonic, diuretic and cholagogue. They have now been examined chemically with a view to isolate any crystalline components that may be present. The air-dried material gave a figure of 4·8 per cent. for moisture and 11·0 per cent. for ash which was rich in potassium and calcium. The fresh flowers have a mild characteristic smell but from the stem distillate no essential oil could be isolated even by resorting to extraction with petroleum ether. Extraction of the dry material with different solvents in succession gave the following results: (1) Petroleum ether extract 5·3 per cent.; (2) ether extract 0·7 per cent.; (3) chloroform extract 0·8 per cent.; and (4) alcohol extract 11·6 per cent. The first consisted mainly of wax and oil. Cold acetone removed most of the oil and from the residue, by repeated crystallisation from absolute alcohol, a wax having the following properties was obtained: m.p. 69-72°; acid value 10·5; saponification value 29·8; unsaponifiable matter 75·5 per cent. The ether exract (2) was a greenish wax solid and seemed to consist mainly of carotenoid pigments. The chloroform and alcohol extracts (3) and (4) contained some basic substances which gave positive tests with some of the alkaloidal reagents. The alcohol extract contained in addition much resin and some mineral matter. A final water extract was rich in reducing sugars and in potassium and calcium salts.

For the isolation of the basic constituents the air-dried flowers were directly extracted with boiling alcohol. The syrupy residue obtained by the concentration of the extract *in vacuo* was poured with stirring into a large volume of 1 per cent. aqueous hydrochloric acid. The clear aqueous solution containing the salts of the bases was freed from non-basic substances by extraction with chloroform, then rendered alkaline with ammonia and repeatedly extracted with chloroform. The combined chloroform solution was washed with water, dried over potassium carbonate and distilled. The dark brown amorphous residue gave the following reactions with alkaloid reagents.

Colour Tests

Mecke's reagent (Selenious acid in sulphuric acid)—Reddish brown.

Mandelin's reagent (Ammonium vanadate in sulphuric acid)—Brown with violet tinge.

Other common reagents—Negative.

Precipitation Tests

Mayer's reagent—White.

Picric acid—Yellow.

Potassium bismuth iodide—Orange.

Iodine in potassium iodide—Scarlet.

Auric chloride—Pale yellow (small rectangular plates).

The yield of the bases was so poor that it was not possible to obtain any crystalline salts with the amount of substance available. The

possibilities of getting larger quantities of the flowers for investigation in the immediate future are remote in view of the difficulty of collection. Since Ghosh *et al.* (*loc. cit.*) have not described the colour reactions of the basic substances isolated by them it is difficult to compare with properties of the bases of the flowers with those of the bark.

The above results indicate that the medicinal properties of moringa flowers are to be ascribed partly to the basic constituents present in traces and partly to the inorganic salts (potassium and calcium) present in fair amounts. Since the essential oil is present only in insignificant amounts the dried flowers should be almost as useful as the fresh ones.

The authors' grateful thanks are due to Prof. T. R. Seshadri for his kind interest in this work.

S. RANGASWAMI.
S. SANKARASUBRAMANIAN.

Andhra University,
Waltair,
October 10, 1946.

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ON THE COMPOSITIONS OF CUPRIC AMMINO CHLORIDES

IN continuation to our previous work[1] on cuprammonium compounds, I have studied the compositions of the cupric amminochlorides by the electrical conductivity method. The experimental procedure was the same as described in our previous publications.

The composition-percentage difference in conductivity graph gave breaks corresponding to three, four, five and six molecules of ammonia for a molecule of cupric chloride. These results confirm the existence of the well-known hexa-, penta- and tetra-ammino compounds of cupric chloride. I do not get the evidence for the existence for 3 $CuCl_2$, 10 NH_3, but instead I get a break in the curve corresponding to the composition of the compound, $CuCl_2$, 3 NH_3. It appears that the previous workers isolated a mixture of the tri-ammino compound with the higher compounds and hence this anomaly in the result.

Detailed results will be published elsewhere.

I thank Dr. A. K. Bhattacharya, Head of the Chemistry Department, University of Saugor, for his kind interest in this work.

Department of Chemistry,
University of Allahabad, ARUN K. DEY.
May 20, 1946.

1. Dey and Bhattacharya, *Curr. Sci.*, 1946, **14**, 69, 201. 2. —, *Proc. Ind. Acad. Sci.*, 1946, **23A**, 259. 3. —, *Nature*, 1946, **158**, 95.

THE OCCURRENCE OF THE LAKI SERIES IN JODHPUR STATE

OF the Tertiary rocks in Jodhpur State nothing more is known than what is contained in "The Geology of Western Rajputana" (*Memoirs Geological Survey of India*, Vol. 35, Pt. 1, 1902), by Tom D. La Touche.

"The upper limit of the sandstones (Barmer sandstone)", he wrote, "is concealed by the alluvium of the plain, and nothing can be seen of the overlying beds. A fine unctuous clay or fuller's earth, which may overlie the sandstones, is found at Kapurdi, a village about twelve miles to the north of Barmer, and is quarried for sale as "Multani Mitti". It may be of lower Tertiary age, for the same substance is found and quaried to the north-east in Jaisalmer and Bikaner territory and is there associated with numulitic limestone" (pp. 33-34).

A reconnaissance survey of the western part of the State was recently made. Unfortunately, however, in the rocks exposed in the area extending from Barmer to Gunga in a north and south direction and from Akli to Bhiyar in an east and west direction no outcrops of the numulitic limestones could be detected. The outcropping rocks comprised sandstones, various clays and ferruginous shales but did not reveal the presence of any fossils.

A search was then made in the Kapurdi (Long. 71° 22′ 30″:25° 54′ 30″) fuller's earth bed for any fossil remains and the following were detected:—Nuculana (Sacella) sp.; Tibia sp.; Trachycardium sp.; Corbula sp.; of micro-foraminifera, Ammobaculites and Cibicides sp.

An indeterminate echinoid and an indeterminate gastropod were also detected.

Both the fossils, Nuculana, and Cibicides belong to forms which have so far been found only in the Laki.

In a recently excavated well at Nagurda (Long. 71° 24′ 20″: 26° 9′ 15″) about twenty miles north of Kapurdi some more fossils were collected.

The section exposed in the well is as follows:—Lime kanker 0-8 ft.; Loose sand with quartz pebbles 8-21 ft.; Fuller's earth 21-36 ft.; Mud-stone 36-42 ft.; White fireclay 42-70 ft.; Yellow soft sandstone 70-83 ft.; Loose yellow sands 83-90 ft.; Spongry ferruginous sandy shale 98-108 ft.

The fossils collected here contained *Lucina metableata*, Corbula sp., Nucleana sp.; Venericardia sp., Pitar sp. Of microparaminifera, Ammobaculites, Bathysiphon, Cibicides. Globigerina sp., Lagena sp., Rotalia sp., Trochammina sp. nov., and Turrilina were identified The forms of Cibicides and Turrilina detected here have so far been found only in the Laki. Of Ostracoda, three different forms of Cythereis were identified. All the above came from the fuller's earth bed. The only fossil detected in the fireclay bed above, was Discors sp.

Most of the fossils belong to species which do not carry published names, but were identified with the help of specimens in the Burma Oil Company's collection.

My grateful thanks are due to Messrs. P. Evans, J. Coates and F. E. Eames, of the Burma Oil Co., Ltd., for invaluable help in the determination of the fossils.

Dept. of Mines and Geology,
Jodhpur. S. K. BOROOAH.
August 31, 1946.

NITROGENOUS FERTILIZERS IN RELATION TO THE KEEPING QUALITY OF POTATOES

Russell and Garner (1941),* studying the effect of manuring on the keeping quality of potatoes stored in the outdoor pits, found that about 7 per cent. by weight of the potatoes went bad on storage; dung in the bouts increased this loss to nearly 9 per cent. Sulphate of ammonia had but little effect; superphosphate and potash did not decrease the loss but if anything, increased it. This note deals with the effect of storage on the rotting of potatoes, variety: Darjeeling Red Rose, grown at the College Farm during 1943-44 and fertilised with ammonium sulphate at 80 lbs. N per acre, applied before planting. Tubers from control and manured plots were each divided into big and small groups, those weighing above 45 gms. per tuber being classed as big. They were then stored separately in wooden trays between sand layers from March 15, 1944 to September 13, 1944. The rotted tubers were removed at definite intervals and the mean temperature of the storage room recorded for these periods.

Percentage of Rotting in Tubers Harvested from Manured and Unmanured Plots

Period of storage from March 15, 1944 (Days)	Mean temp. during storage (°C.)	Size of tubers	Per cent rotting in tubers harvested from	
			Manured plot	Unmanured plot
20	22·5	Small	0·14	0·24
		Big	nil	nil
40	26·9	Small	0·99	1·45
		Big	2·15	2·60
59	32·0	Small	1·70	2·97
		Big	6·45	7·79
90	33·8	Small	6·38	16·62
		Big	19·35	40·26
120	31·2	Small	18·86	34·49
		Big	36·55	58·44
150	27·7	Small	21·27	36·56
		Big	40·86	64·93
180	27·7	Small	23·50	37·50
		Big	45·21	66·20

It may be observed from the results (Table) that (1) as commonly observed, the small tubers had a better keeping quality than the big tubers; and (2) ammonium sulphate application increases rotting on storage.

The high percentage of rotting that usually occurs in storage at normal temperatures might thus be due to nitrogenous fertilizers which are frequently applied to the potato crop. However, as high yield of potato tubers depends also on adequate supply of nitrogenous fertilizers, it is advocated that a small unmanured plot may be planted with potatoes, its produce alone being retained for storage and subsequently, for seed.

Benares Hindu University, K. Kumar.
October 1, 1946. S. L. Tandon.

* Russell, E. J., and Garner, H. V., *Emp. J. Expt. Agri.*, 1941, **9**, 227-35.

ON THE LEPTOCEPHALUS OF *UROCONGER LEPTURUS* (RICHARDSON) FROM THE MADRAS PLANKTON*

Different types of Leptocephali occur in the Madras Plankton, and of these, two of the common varieties have been correlated with their adults (namely, *Murænesox cinereus* and *Muræna macrura*) by allowing them to metamorphose into the adult eels in the Laboratory aquarium tanks (Nair, 1946). Owing to the difficulty of obtaining these larvæ in the living condition from the townet collections, this conclusive method of identification is not always possible and as such the usual method of correlation by myotome and vertebral count has to be employed for identifying the other species.

The Leptocephalus of *Uroconger lepturus* appears in considerable numbers in the Madras Plankton generally during the months of January to April.

Measurements

Total length 112 mm.; length of head 6 mm.; length of trunk 76 mm.; length from anus to tip of tail 30 mm.; length from tip of snout to origin of dorsal fin 43 mm.; maximum height including dorsal fin 11 mm.

The Leptocephalus is transparent with a highly flattened body having 216 myotomes approximately. The posterior portion of the body gradually tapers into a finely pointed tail (Fig. 1) and in this respect the larva resem-

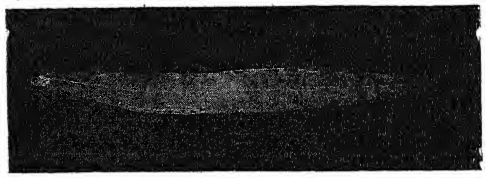

Fig. 1. Leptocephalus of *Uroconger lepturus*. × ½

bles *Leptocephalus acuticaudatus* described by Kaup (1856) from Malabar. The head is roughly triangular in shape with large eyes and a blunt snout (Fig. 2). The jaws are of nearly

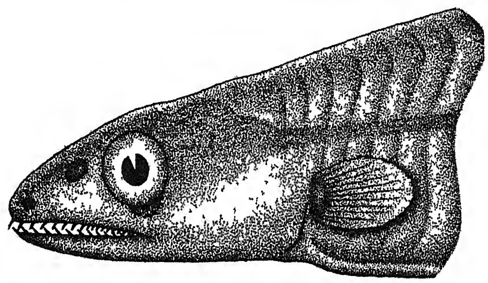

Fig 2 Head region of the Leptocephalus of *U. Lepturus*. × 6·5.

the same length and carry forwardly directed pointed teeth. The upper jaw has about 22 teeth of which the anterior 8 are stronger and longer than the remaining ones. The lower jaw has about 14 teeth. The cleft of the mouth is straight and extends to about half the length of the head. The alimentary canal is very long and takes a straight course with the anus opening to the outside below the 116th

myotome. Indications of the rays are present in the pectoral fin.

A group of black chromatophores is present below the eye and this pigmentation is a characteristic feature of the larva. A series of large black chromatophores is present arranged in a line along the lateral line and the chromatophores are situated on the myocommas with regularity. Occasionally a myocomma may be present without a chromatophore. A similar series of black chromatophores is found along the ventral margin directly above the alimentary canal. The pigment cells of this series are smaller, numerous and closely arranged than those of the mid-lateral series. These chromatophores are elongate excepting some of the anterior ones. The anteriormost and the posteriormost region of the body are generally without any pigment cells.

In the majority of examples collected the larval set of teeth has dropped out and indications of the adult set are seen as minute conical projections. Further, in these specimens, the length of the alimentary canal is considerably reduced with the anus occupying a very anterior position. These changes evidently show that metamorphosis has commenced in these larvæ.

Uroconger lepturus is a common eel of the Madras Coast and Alizarin preparation of a medium-sized specimen showed 218 vertebræ. The vertebral number of the adult is approximately similar to the myotome number of the larva and this similarity shows clearly that the Leptocephalus is that of *Uroconger lepturus*. Further evidence in support of this correlation is given by the fact that this is the only species of larval and adult eel with a tapering and whip-like tail occurring along the Madras Coast.

I am thankful to Dr. N. Kesava Panikkar for his helpful suggestions.

Zoological Research Lab.,
University of Madras, R. VELAPPAN NAIR.
September 20, 1946.

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* Work carried out under a scheme of research financed by the Imperial Council of Agricultural Research, New Delhi.

A NATURAL FUNGOUS PARASITE OF POWDERY MILDEW ON *CYAMOPSIS PSORALIOIDES* DC.

AN interesting case of a fungus parasitizing another fungus came to light recently in Bangalore. During September-October this year, there was a profuse development of powdery mildew, *Leveillula taurica* (Lév.) Arn., on the cultivated cluster bean or *gori kayi* (*Cyamopsis psoralioides* DC.). On the mildew patches, greyish points were prominent, and these on examination proved to be groups of pycnidia of the parasitic fungus, *Cicinnobolus cesatii* De Bary. This is an imperfect fungus belonging to the group of the Sphæropsidales. The pycnidia are light-brown in colour, and oval in shape, with a thin pseudo-parenchymatous wall. They extrude numerous small hyaline, oval or oblong spores. The measurements of the pycnidia and spores agree fairly closely with those recorded by Sydow and Butler. The pycnidia measure from 52-72 μ long by 36-50 μ broad, average being 59·9 μ $\times$ 42·4 μ (against 45-104 μ $\times$ 39-60 μ, mostly about 60 $\times$ 40-45 μ), and the spores 7-9 μ long by 3-4 μ broad, average being 7·6 μ $\times$ 3·65 μ (against 5-8 μ $\times$ 2·5-3·5 μ). *Cicinnobolus cesatii* has been recorded on the oidial stages of many powdery mildews, and is sometimes known to aid in checking them. The extent of control cannot apparently be very great, as the mildew thrives in spite of the parasite, and brings about, under favourable conditions, a large amount of leaf-fall. Nevertheless the existence of the parasite is most probably a check to the full development and spread of the mildew.

The fungus, *Cicinnobolus*, was first observed by Cesati in the province of Tuscany in Italy in the year 1852, and was described by Tulasne from France in 1853. De Bary, about the year 1870, proved the parasitism of the fungus on the powdery mildew, *Oidium Tuckeri*, and *O. erysiphoides*, occurring on the leaves of the grapevine and other plants. *Cicinnobolus cesatii* has been noticed all over the world, and particularly in Italy, France, Portugal, Holland, Great Britain, Egypt, Canada and United States of America, on the mildews of various plants, Sydow and Butler* described it for India from a collection made by Butler at Pusa in October 1910 on *Oidium* sp., occurring on *Phaseolus mungo* var. *radiatus*. There is no other mention of this fungus in India. Hence this record of its occurrence on *Leveillula taurica* (Lév.) Arn. is new to India.

Department of Agriculture,
Bangalore, S. V. VENKATARAYAN.
October 9, 1946.

* Sydow, H., and P., and Butler, "Fungi Indiæ orientalis," *Pars. V. Annales Mycologici*, 1916, **14**, **190**. See also Butler, E. J. and Bisby, G. R., "The Fungi of India," *Sci. Mono.* **1**, *Imp. Coun. Agr. Res.*, **1931**, **152**.

A PRELIMINARY NOTE ON A NEW KARYOTYPE IN *SCILLA INDICA* BAKER

RAGHAVAN AND VENKATASUBBAN (1939) in their studies on the Indian Scillæ, have described three distinct karyotypes in *Scilla indica* Baker, with the diploid chromosome number as 44, 45 and 46.

The plant under investigation was collected on the Kolar hills in Mysore State, and has been found to represent another disitnct karyotype revealing a diploid chromosome number of 30 ; this number has not so far been reported in the species.

Scilla indica Baker, collected by us is a small bulbous plant flowering in May. The root-tips were forced in water culture, fixed in Levitsky's chromic-formalin and stained with crystal violet (after La Cour). Fig. 1

shows the thirty chromosomes in the somatic metaphase plate. There are two pairs of very

FIG. 1. Somatic metaphase plate × 4050.

large chromosomes and the size of the chromosomes suddenly diminishes, consisting of six pairs of medium-sized and seven pairs of small

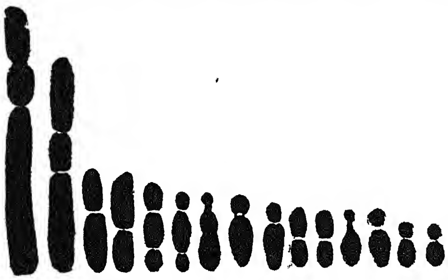

FIG. 2. Idiogram of the somatic haploid complement × 4050.

chromosomes. The constrictions are mostly submedian and subterminal.

Further work on the meiotic chromosomes and the other aspects is in progress.

The authors wish to express their grateful thanks to Dr. K. V. Srinath for helpful criticisms, and Dr. L. N. Rao for kind encouragement.

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Bangalore, M. H. SRINIVASA MURTHY.
October 24, 1946.

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USE OF COAGULATED PLAIN SERUM FOR MAINTENANCE OF CORNYBACTERIUM *DIPHTHERIAE*

DUDLEY (1923) recommended plain serum instead of Loeffler's medium containing glucose broth for maintenance of toxin-producing strains of *C. Diphtheriæ*. Recently Forbes *et al.* (1945) tried coagulated plain serum (C.P.S.) in an outbreak of Diphtheria and found it much superior to Loeffler's medium for isolation of *C. Diphtheriæ* from throat swabs.

In this laboratory, stock cultures of toxin-producing strains of *C. Diphtheriæ* (P.W. 8) were maintained on Loeffler's medium and on C.P.S. side by side to find out whether repeated subcultures on C.P.S. affect the toxicogenicity of the strain.

Preparation of the Medium.—The C.P.S. was prepared with serum from normal horse blood. The fresh serum, sterilized by seitz filtration, was inspissated at 75° C. for 45 minutes for one day only

Comparison of the C.P.S. and Loeffler's Serum Media.—Pellicles from 18 hours growth of *C. Diphtheriæ* in dextrose broth were seeded into Loeffler's and C.P.S. tubes. The results obtained after 12 consecutive subcultures at intervals of 14 days are summarised in Table I.

TABLE I

Strain used	Medium used		
	C.P.S.	C.P.S. + 0·25 p.c. Glucose	C.P.S. + 0·25 p.c. glucose + ⅓ vol nutrient broth
Park William 8	+++ =	+++	++++

(+ indicates intensity of growth)

On C.P.S. and C.P.S. with 0·25 per cent. glucose (Table I) the time taken for maximum growth was longer (48 hours) than on Loeffler's medium (24 hours). On first few subcultures, the growth was scanty but after 4 or 5 subcultures, the growth was satisfactory, though not as good as with Loeffler's medium.

Morphological character of the organisms did not alter after repeated cultures on C.P.S. or on C.P.S. with 0·25 per cent. glucose.

For maintenance of stock culture, subcultures were done every 14 days on the different media. For production of toxin, fresh cultures were made on the respective media. After 24 hours incubation, they were charged into dextrose broth tubes and finally into broth flasks to obtain toxin. The average potency of toxins (Lf. doses per c.c.) are recorded in Table II.

TABLE II

(Figures indicate Lf. doses per c.c. of toxin—average of 12 experiments)

Strain used	C.P.S.	Medium used for maintenance of stock cultures	
		C.P.S. + 0·25 p.c. glucose	C.P.S. + 0·25 p.c. glucose + ⅓ vol nutrient broth
Park William 8	28	28	28

DISCUSSION AND CONCLUSION

It appears (Table I) that on C.P.S. growth of the toxin-producing strains of *C. Diphtheriæ* (P.W. 8) is not as good as on Loeffler's medium.

Probably glucose and broth supply additional nutrient as growth promoter. The toxigenicity of the organism was not affected on repeated subculture on C.P.S. over a period of six months. The C.P.S. medium is very simple. For laboratory diagnosis of diphtheria, where detection and isolation of the organism is of primary importance, the C.P.S. has been observed to have advantage over Loeffler's medium. But for maintenance of stock strain for routine production of toxin, it is yet too early to recommend its use in preference to Loeffler's medium though results obtained so far are encouraging. Further work in the line is in progress.

Our thanks are due to Dr. P. N. Basu, M.B., for his interest and guidance in the work.

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SUDHANGSU BARDHAN.

Serum Department,
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Calcutta,
October 19, 1946.

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A RICE DIET FOR THE PRODUCTION OF EXPERIMENTAL FATTY LIVERS

THE deposition of fat in the liver has become a subject of major interest in biochemistry since it was shown that dietary factors play a dominant role in liver-fat deposition and that conditions predisposing to fatty livers in short-term experiments cause liver cirrhosis in more prolonged experiments.[1,2,3,4,5 6] Excessive amounts of fat[7] or carbohydrate[8] in the absence of a sufficiency of choline,[9] methionine[10] or protein[11] are the chief dietary factors that have been shown to be responsible for the production of fatty livers. For the purpose of investigating dietary factors involved in the æriology of infantile cirrhosis of the liver, which is widely prevalent in S. India, and for studying the lipotropic activity of proteins and protein hydrolysates, it became necessary to devise a carbohydrate-rich experimental diet based upon rice and with rice as the sole source of protein, which would cause fat infiltration into the liver. It was found that fatty livers could be easily produced experimentally in rats by the use of a diet approximating in protein and carbohydrate content to the S. Indian vegetarian diet. The results of experiments on groups of animals maintained on diets of the following composition (Table I) are described here.

TABLE I
Per cent. Composition of Diets

	Rice Flour	Rice Protein	Casein	Coconut Oil	Sucrose	Salt Mixture*
Diet I (Protein, 20%)	58	0	16	15	7	4
Diet II (Protein, 5%)	58	1	0	15	22	4
Diet III (Protein, 5%)	58	1	0	25	12	4

* Steenbock-Nelson Salts 40.

All these food mixtures had as their basis 58 per cent. raw rice flour, supplying approximately 4 g. of protein. Diet I for the control animals, contained in addition 16 per cent. casein. In Diets II and III the protein content was brought to 5 per cent. by addition of about 1 per cent. of pure rice protein, prepared by the method of Tadokoro.[12] The exact quantity of rice protein to be added was determined by an estimation of the protein content of rice flour, which was usually 6·9 per cent. (N × 6·25). Diets I and II contained 15 per cent. fat (refined coconut oil) and Diet III 25 per cent. fat. Each rat received in addition 1 drop cod liver oil and the following supplements of vitamins of the B complex, per day: 25 micrograms thiamin hydrochloride; 20 micrograms riboflavin; and 20 micrograms pyridoxin.

Young albino rats, approximately 70 g. initial weight, were placed in groups of 6, animals of the two sexes being distributed evenly between the groups. The food was provided *ad lib.* and the daily intakes recorded. Weighing of animals was done twice a week. After 35 days on the diets the animals were killed by stunning. The livers were immediately removed and individually worked up for the determination of total crude fatty acids (fatty acids+unsaponifiable matter) according to the method used by McHenry and Gavin.[13]

The results are summarized in Table II.

TABLE II
Groups of six rats maintained for a period of 35 days

Diet	Av. food intake (g./day)	Av. Final body wt. (g.)	Av. change in body wt. (g)	Liver		
				Av. fresh wt. (g.)	%Body wt.	Crude fatty acides (% fresh liver wt.)
I	8·0	107	+30·5	3·52	3·45	4·47±0·22
II	6·0	90	+11·0	4·49	5·00	9·06±1443
III	5·5	72·5	+4·1	3·63	5·03	8·84±0·99

It will be seen that in the animals on the low protein diets the fat-content of the liver

is about twice that of the normal animals on a balanced diet. There is no significant difference in the liver-fat deposition in the groups receiving 15 and 25 per cent. fat. These results were always found to be reproducible. The weight curves of the animals (Fig. 1) are in-

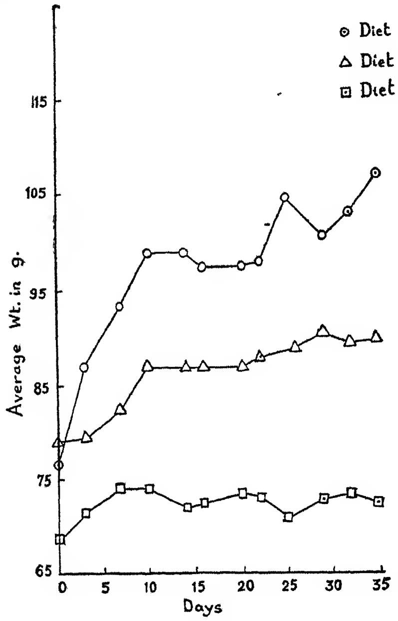

FIG. 1. Weight Curves

structive. Curve I is the usual growth-curve of rats receiving a complete diet. Curve II, representing the animals on a low protein diet with 15 per cent. fat, shows a slow but steady increase in weight; while with Diet III, containing 25 per cent. fat, it is obvious that the imbalance is so great that the animals show hardly any growth. For this reason Diet II is recommended as the most suitable for the study of lipotropic factors, as it has been pointed out by other authors (cf. Handler[14]) that characteristic fatty livers in young rats are not produced when dietary factors present do not permit at least slow growth.

M. DAMODARAN.
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University Biochemical Lab.,
Madras,
September 17, 1946.

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ASTROPHYSICS AND V-2 ROCKETS

THE military program of V-2 Rocket firing at White Sands, N.M., is enabling astronomers to use "extremely expensive apparatus for the exploration of the upper air, and for making preliminary observations outside the major portion of the atmosphere," according to Dr. J. Allen Hynek, of Perkin's Observatory.

The rocket to be fired on October 24th will be equipped by the Johns Hopkins group, carrying principally apparatus for recording the intensities of cosmic rays and for photographing the far ultra-violet spectrum of the sun. At the Astronomers' meeting, Dr. Hynek described the spectrograph designed for the solar observation; its successful operation would for the first time release astronomers from the limitation of earth-bound instruments. They have yet to observe extra terrestrial radiation of wave-lengths shorter than about 3,000 Angstroms because it is absorbed by the ozone and other layers in the rarefied upper air.

As ordinary glass also absorbs ultra-violet, the prisms and lenses of the spectrograph are of lithium fluoride with which it is hoped to reach 1,500 Ångstroms or better. The film-recording mechanism consists of a ten-sided rotating steel rod, eight sides of which have affixed to them strips of film. The entire plate holder is encased in a light-tight steel cylinder which preliminary drop tests have shown to be exceedingly rugged. Clockwork controls the exposures, turning successive faces of the polygon into the focal plane as the flight progresses.

It is evident, however, that aiming the spectrograph so that the sun will shine exactly into the slit will be practically impossible. A small hemisphere of lithium chloride placed over the slit will act as a diffuser to pick up sunlight even if the apparatus is not pointed directly to the sun. The V-2 is known to rotate slowly about its longitudinal axis, and the hope is that at least some of the exposures will be taken in a favourable aspect.

Uncertainty in the intensity of the radiation, in the transparency of the sky, and in the orientation of the slit make exact exposure prediction difficult, so a step-slit will be employed, making the exposure at one end considerably shorter than at the other. The dispersion will be 50 Ångstroms per millimetre.

—(Courtesy of *Sky and Telescope, October* 1946, p. 7.)

REVIEWS

Forest Soils and Forest Growth. By S. A. Wilde. (The Chronica Botanica Co., Waltham, Mass.; Macmillan and Co., Ltd., Calcutta), 1946. Pp. i-xx + 1-241; 7 plates and 24 figures. Price $5.00.

Many books have been written by foresters about the forest plant community as a vegetative complex and many books have been written by soil scientists regarding the soil as an intimate biological whole. This book, however, is one of the few which regards the soil and the forest growing on it as one great harmonious complex.

Until quite recent years soil scientists have in general neglected serious considerations of the vegetation that grows or can grow on the soils they were examining and foresters often have paid all too little attention to the soil that supported their forest. In the very early pages the author aptly quotes a forester who described the situation that existed not so long ago:—

"How well I remember the many hours of careful measurement we used to make to determine the volume of a stand and then kick our heel into the ground, grab a fist-full of soil and litter and determine the soil that made this growth possible in the twinkle of an eye."

The book originated from a series of lectures prepared for a rather heteregeneous group of students including graduates and advanced students in soils, forestry, botany, game management, and landscape architecture and hence its broad and somewhat unconventional treatment of the subject.

The author begins with a historical introduction showing how the studies of soils and forests started separately and how gradually they necessarily came together. He then deals with how soils came into being and how they have been classified. He continues with a description of the forest vegetational cover of the soil and shows its biological structure and relation to environment. This is followed by detailed descriptions of forest soils separately for the aspects of their physical properties, chemical properties, their living population of organisms both large and small, and the humus which is the forest's great organic contribution to the soil in the form of dead and decaying vegetation.

Having thus covered the soil, the forest, and their interdependence, forest soil types are described and details are given of forest soil surveys and how they are carried out.

Following this is a series of chapters dealing with the effect of the soils on the forests and the effect of different kinds of forest management on the soils. One of the big problems dealt with is the amelioration or improvement of forest soils by the use of fertilisers, manures and composts. This is often necessitated by the fact that in general only the poorest soils are legitimately used for forests while the better soils are usually reserved for agriculture. In addition, it often happens, that in order to use these poor soils set aside for forests, the type of forestry is determined by the needs of the local people or local industries. These uses may necessitate methods of forest management which are often not the best for maintaining and improving the fertility of the soil and hence some form of amelioration or modification of forest management becomes essential. Nowhere is this felt more heavily than in permanent forest nurseries where year after year crops of young tree plants are grown on the same site. A typical example of this is in the great shelter belt scheme of the U.S.A., in which in the last ten years they have raised many thousands of miles of tree shelter belts to try and fix the shifting and wind-blown soils of the great "dust bowl". This necessitated the raising of many millions of forest trees in nurseries near the planting sites on soils not usually suitable for the purpose. Only the greatest care in maintaining the fertility of the soils of these nurseries enabled the project to be carried through successfully.

The book is well printed and is very readable although it is definitely not popular in style but of the text-book variety. It is well illustrated by a number of text-figures. One criticism, however, must be made. At the end we find a number of plates each of which contains half a dozen or more photographs. They are excellent photographs which well illustrate the points they are intended to cover and it appears a pity that more was not made of them. They are jammed up on the pages and tend to lose their effect by their smallness. A book of this kind deserves better illustration production. It concludes with a comprehensive bibliography of over 600 references.

This publication will be greatly welcomed by foresters and soil scientists alike for it is real and practical and not academic only in its outlook as are so many books on forestry and on soils. It truly presents the soil and the forest growing on it as a teeming living harmonious complex and not just a mixture of mud and wood.

A. L. GRIFFITH.

Vitamins and Hormones, Vol. III. Edited by Robert S. Harris and Kenneth V. Thimann. (Academic Press Inc., New York), 1945. Pp. xv + 420. Price $6.50.

The third volume of this internationally recognised and eagerly welcomed series of publications needs no introduction. It includes nine articles, each of them representing an authoritative and critically appraised review. The interrelation of vitamins in its functional, unbalanced dosing, toxic and synergic aspects, is discussed by Moore; in the author's own words, "any attempt to co-ordinate, rather than to collect together, the examples of interrelation so far reported might at the present stage only make confusion worse confused. If we

accept the evidence now available at its face value, however, we must infer that interplay between vitamins is extensive and complicated. The various roles of riboflavin may be taken as affording a good illustration of the complexity of the problem: (1) We are told that this vitamin reacts with ascorbic acid *in vitro* under the influence of light; (2) it is present in the retina where it possibly interacts with vitamin A in the formation of visual purple, and on separate evidence is concerned with vitamin A and ascorbic acid in dark adaptation; (3) it is associated with thiamine and niacinamide in oxidative mechanisms for carbohydrates; (4) possibly it takes part with niacinamide in protein metabolism; (5) there is a suggestion that it has some correlation with synthesis or metabolism of ascorbic acid; (6) finally it is said to prevent the injurious effect of marine fatty acids, which are in turn antagonistic towards vitamin E. Such a "diversity of interests" may be claimed for several other vitamins, which leads, at least on paper, to a complicated network in which almost any two factors which have not been proved to interact directly may be assumed to influence each other through their relations with a third factor."

The second review in the volume on the Bacterial Synthesis of B Vitamins in the Intestines, is one of the great theoretical interest and practical significance in human nutrition. Can man and beast attain a state of self-sufficiency, complete or partial, with respect to the B-complex? If so, what is the extent and the manner through which it is accomplished? An up-to-date answer to these questions is furnished by this article. Of even greater importance and significance to animal and human nutrition is the fourth article on Prenatal Nutrition Deficiencies. The author has focussed attention of interested investigators in this field on problems which await solution; says the author, "The appearance of the mother does not always betray her nutritional state and in case of deficiency the fœtus may suffer more than the mother. It has been shown in animal experiments that a vitamin A level sufficient for maternal health may result in disaster to the offspring; and vitiamin A-deficiency does not affect the teeth of the mother so severely as those of the young. A mother with latent beriberi may give birth to a child with congenital manifestations of the disease. Female rats with a riboflavin deficiency so mild that they can undergo repeated pregnancies, often give birth to young who have the most severe malformations. Female animals fed on iron-deficient diets without developing anæmia produce iron-deficient offspring that develop anæmia. These examples will suffice to illustrate that in the struggle for nutritional factors between mother and offspring it is not always the fœtus who obtains what he needs. The finding of critical periods in the development of the embryo, in which there is unusual susceptibility to nutritional deficiency, opens new perspectives in the field of prenatal nutrition. It emphasizes the importance of a satisfactory nutritional state of the mother in the earliest periods of pregnancy."

The fifth review is devoted to a comprehensive and critical discussion of the growth-factors in microbiology and covers more than a fourth of the volume (125 pages). This is a field in which biochemists, medical bacteriologists and fermentation technologists are all interested. The seventh contribution relates to a discussion of the chemistry of the anti-pernicious anæmia substances of liver; it is written by one who has made substantial contributions to the field. The article is an admirable review of a difficult and controversial field and gives a clear picture of the present status of the subject. Other articles in the volume include (1) Sulphonamides and Vitamin Deficiencies, (2) Possibilities in the Realm of Synthetic Estrogens, (3) The Mechanism of Action and Metabolism of Gonadotropic Hormones in the Organism and (4) The Role of Acetyl Choline in the Mechanism of the Organism. On the whole the volume has fulfilled the high expectations of the wide circle of scientific investigators interested in vitamins and hormones, not only in the matter of the choice of the topics but also in the choice of the reviewers. We share with the Editors the hope that "the subject-matter of successive volumes will integrate more and more until *Vitamins and Hormones* eventually becomes a complete reference to all active research in the vitamin and hormone field".

Annual Review of Physiology, Vol. VIII. By James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews Inc., Stanford University P.O., California), 1946. Pp. viii+658. Price $5.00.

The eighth issue of the *Annual Review of Physiology* contains twenty-five reviews. Prefacing the volume, the Editors restate their declared Editorial policy in the preparation of these reviews. "Encouragement is given only to the preparation of reviews which survey the important contributions of the preceding year or biennium, which appraise them critically and evaluate with descrimination the present status of the subject. Comprehensive reviews in which the task of the author is one of compilation rather than of appraisal are deliberately eschewed". The Editors have felt convinced that the special function of the review should lie in criticism and appraisal; this policy is largely reflected in the reviews.

War-time restrictions on the publication of the results of physiological research, more especially in its applied aspects, however, continue although to a less severe degree. When the ban is lifted, may we expect a flooding of the pages of these *Annual Reviews* with an account of the spectacular achievements made under the stimulus of war.

The topics discussed in the volume cover, in addition to the familiar subjects, a few fresh aspects of physiology; Blood Cytology and Aviation Physiology represent two such topics. The volume is generously documented (3,598 references to literature) thoughtfully indexed and attractively got-up. These reviews will continue to have ever expanding circulation and constitute an indispensable part of all progressive libraries interested in the advancement of physiological research in its fundamental and applied aspects.

The Genus Bazzanla in Central and South America. By Margaret Fulford. (Waltham, Mass.: Chronica Botanica, Ltd.; Calcutta: The Macmillan & Co.), 1946. Pp. 175. Price $5.00.

Taxonomic hepatacologists of the 19th century based their studies on herbarium specimens alone. This has led to an unnecessary multiplication of species and found a climax in the monographs of Stephani. Dr. Kashyap and Dr. Verdoorn were greatly impressed by the range of variability shown by Hepalics, when studied in the field and felt the necessity of critical revision of literature of a close examination of the herbarium material. Dr. Verdoorn has given this idea a practical shape by arranging to publish such monographs.

This excellent monograph by a hepatacologist of long standing is the fifth of the series arranged by Dr. Verdoorn (1-4 already published as supplement, Vols. I-IV of *Ann. Bry.*). The author's name is well known to all interested in Bryology. This monograph incorporates suggestions from Dr. Evans—the nestor of American hepatacologists. The author has critically examined herbarium materials of 100 species and varieties of genus *Bazzania*. One of them has been transferred to another genus and as many as 71 have been reduced to synonomy. This should bring home to all taxonomists that they should be very careful in describing new species. It is an excellent model and like other monographs of the series published already is bound to be of immense use to all interested in the subject.

R. S. C.

Biochemical and Allied Research in India, Vol. 15. (Society of Biological Chemists, Bangalore, India), 1944. Pp. 87. Price Rs. 3 or 6 *sh.*

The Society of Biological Chemists of India has been responsible for issuing these extremely useful and informative Reviews during the last fifteen years; they have been instrumental in focussing attention on the highlights of scientific achievements in the field of Biochemical Research in this country. That the Society has been able to continue these annual publications even during the difficult years of the World War and to maintain a reasonably high standard in the presentation of these reviews, is a matter on which the Society may well feel proud.

These reviews can play a more useful and a more purposeful part if the Editors of the *Review* could infuse new blood into the reviews. Reviews of the work done in India may with advantage be critically appraised and comparatively presented against an international background of work in similar and allied fields. India is backward in many fields of scientific endeavour; the reviewer might in all appropriateness, point out the *lacunæ* existing in our research organisations and plead for the inauguration of new lines of and fresh approaches to research and emphasise the urgent need for an immediate modernisation of our techniques and laboratories.

We have no doubt that these suggestions will receive the earnest consideration of the Editorial Committee. We shall in the coming years look forward to an even more useful and inspiring series of *Reviews.*

Recent Advances in the Chemistry and Biology of Sea-Water. By H. W. Harvey. (The University Press, Cambridge), 1945. Pp. viii + 164. Price 10*sh.* 6*d.* net.

The study of the marine environment is one of considerable interest to scientific investigators of the flora and the fauna which enrich the life of the sea. The physical and chemical factors which determine the overall 'quality' of the environmental complex, are influenced by a variety of natural causes. The geographical location of the sea, the proximity of lands and estuaries, the presence of oceanic warm springs and streams, the ridges and the ravines of the sea floor, the turbulent flows due to tidal waves and volcanic eruptions, are some of the physical factors which influence the environment. The salinity, chlorinity, concentration of the major and the minor constituents, the phosphatic and the other nitrogenous compounds, the dissolved oxygen and the carbon dioxide, are some of the factors which directly affect the chemical and the nutritional status of the environment.

Dr. Harvey's volume under review is an authoritative contribution to this field of the marine environment in relation to its plant and animal life. In the course of the ten interesting chapters which comprise the volume, the author has summarised in a clear and concise manner the large volume of work which has been carried out in this field. The introductory chapter is devoted to a discussion of mixing and the horizontal transport of sea-water which tend to maintain a certain degree of uniformity of conditions in the sea. The second chapter deals with the salinity, chlorinity and the specific gravity of sea-water. Methods for their determination are described and the inter-relationships of these factors discussed. The third and the fourth chapters describe respectively the major and the minor constituents of the sea. The minor constituents include the organic carbon compounds and the salts containing nitrogen and phosphorus. The fifth chapter deals with dissolved oxygen, its occurrence and distribution at different depths and during different seasons. The carbon dioxide system of sea-water is described in the sixth chapter.

The distribution and estimation of phosphates and of nitrogen-containing salts forms the topic of the seventh chapter; colorimetric and biological methods of estimating phosphates and various forms of nitrogen are described and the significance of the nitrogen/phosphorus ratio discussed. The next chapter is devoted to a discussion of the changes induced by bacterial action; this is followed by a description of the phosphorus and the nitrogen cycles (Chapter IX). The tenth and the last chapter is concerned with the fertility of the ocean waters as determined by the abundance of planktonic harvests, which meet the nutritional requirements of the higher forms of life in which the sea abounds. This is a volume which will be enthusiastically welcomed by every one interested in the fundamental and practical aspects of marine biology.

OXIDATION*

THE discussions organised by the Faraday Society serve to prove the advantage of considering scientific knowledge as international. Attracted by a bond of common interest, experts from far and wide collect together for an unrestricted exchange of ideas about a scientific theory capable of wide applications in its different aspects. Knowledge advances and the world benefits. The general discussion on oxidation held in London was quite up to the reputed traditions of the Faraday Society discussions. These were held at the University College, London, under the Presidentship of Professor E. K. Rideal, F.R.S., and were attended by a number of scientists from the U.S.A. and Europe.

The subject of oxidation is as wide in its scope as it is varied in its aspects. A large number of papers were contributed and were considered under the following:—

(1) Oxidation processes involving electron transfers.

(2) Low temperature oxidation of hydrocarbons.

(3) Oxidation at high temperature in the gas phase.

In most oxidation processes in aqueous media, the first step consists of a simple electron transfer. This, however, is followed by subsequent reactions involving fundamental rearrangements within the molecule. In the present discussions, the electron transfers, the nature of the loose electrons, the ions and radicals formed as a consequence of electron transfers and the reaction chains set up by free radicals, are the main ideas which have been applied to understand the mechanism of secondary reactions in oxidation-reduction processes. The theory of chain reactions as applied to thermal reactions laid the foundations of many of the fundamental ideas. Study of thermal reactions no doubt supplied the tools but their application in a new orientation has opened up a vast field whose extent and fruitfulness has been fully brought out during these discussions.

In systems of conjugated double bonds, Weiss approaches oxidation through an electron transfer resulting in the formation of an unstable intermediary ion. Weiss also considers the quenching of fluorescence of polycyclic hydrocarbons by molecular oxygen as an electron transfer process: $RH^* + O_2 \rightarrow [RH]^+ + O_2^-$, a more or less stable peroxide being formed. He extends the same idea to cases of photosensitised oxidation where an HO_2 radical can be formed, which in the presence of a suitable accepter easily brings about an oxidation. Electronic transfers in oxidation processes, however, often involve complicated rearrangement of bonds within the molecules. In the first paper Coulson has given his method of calculations of bond order, on which depends the reactivity of a bond. Though in matters of detail and the extent of mobility of the π electrons, calculations may have to be revised, the treatment lends a quantitative theoretical basis for the degree of bond fixation and ultimately to reactivity of molecules concerned.

The idea of a chain of mechanism initiated by a free radical has been applied to polymerisation processes of vinyl compounds. Hydrogen peroxide, potassium persulphate and other inorganic substances are known catalysts for polymerisation processes. It has been found that traces of various substances greatly accelerate the rate of polymerisation. With H_2O_2, the rate is markedly acclerated by the presence of ferrous, manganous, cuprous, titanous and other metallic ions. In a series of papers Bacon, Baxendale and co-workers, and Morgan have studied the polymerisation of monomers like methylacrylate, methylacrylic acid, styrene, etc. Polymerisation by H_2O_2 is greatly accelerated by ferrous ions. A new polymerisation technique called *"reduction activation"* which is most effective in aqueous solutions has been worked out by Bacon. The presence of reducing substances capable of reacting with the oxidising agent, accelerates the polymerisation of ethylenic monomers. The increased activities are explainable through the formation of intermediary free radicals or radical ions and thus form evidence for the same. In the case of H_2O_2 and ferrous ions, there is satisfactory evidence for the formation of OH radical. The reaction is accelerated by a chain mechanism, the hydroxyl radical attacking the double bond of the monomer and producing other free radicals which react with further molecules of the monomeric compound in the following manner:

$$HO + M \rightarrow HOM -$$
$$HOM - + M \rightarrow HO(M)_2 -$$
$$MO(M)_n - + M \rightarrow HO(M)_{n+1} -$$

The chain is terminated by mutual reactions between growing chains or by OH radicals thus:

$$HO(M)_n - + HO \rightarrow HO(M)_nOH$$
$$HO(M)_n - + - (M)_nOH \rightarrow HO - (M)_{n+m} - OH$$

Kinetics have supported the general scheme. Other cases of polymerisation are also considered to occur through a transient intermediary. The exact nature of the radical or the intermediary catalyst as in the case of the persulphate reaction are not always definitely known and many assumptions have often to enter into these considerations. Study of kinetics of these reactions affords a powerful instrument to probe into the life and formation of the radicals and rapid developments in this sphere can easily be expected.

The next series of papers deal with low temperature oxidation of hydrocarbons. It has been generally established that hydroperoxides are formed as a first step in the oxidation, and the oxidation products and the mechanisms by which the reactions proceed are, however, not clearly understood. The nature of the oxidation products are generally very complicated and kinetic treatment in many cases is precluded owing to lack of knowledge of experimental conditions suitable for the study of chain sequence. There is a considerable difference of opinion on secondary reactions and on the chain terminating processes.

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* A short review of the general discussion held under the auspices of the Faraday Society at the University College, London, on 27th and 28th Sept. 1945, under the Presidentship of Prof. E. K. Rideal, F.R.S.

The first set of papers deal with oxidation of tetralin. This substance is suitable for the study of oxidation of CH_2 group because of its high oxidation rate and the ease with which it yields an easily separable crystalline solid hydroperoxide in the primary oxidation process. The autoxidation of tetralin, without catalysts, shows an induction period. In the early stages about 95 per cent. of the absorbed oxygen is estimable as the hydroperoxide. The hydroperoxide iitself can function as a catalyst and by its breakdown furnishes free radicals which can generate the chain mechanism. In heavy metal catalysed oxidation of tetralin, the primary reaction is the chain formation of the hydroperoxide, followed by catalysed unimolecular decomposition of the catalyst. In a general way the participation of free radicals is amply justified. It is generally considered that the hydrocarbon RH, gives rise to radicals R−, which react in the sequence :

$$R - + O_2 \rightarrow RO_2 -$$
$$RO_2 - + RH \rightarrow RO_2H + R -$$

The reactions for the termination of the chain are not always definite. Surface effect and reactions with the peroxide or the catalyst have been suggested for the process.

The thermal decomposition of benzoyl peroxide is monomolecular and produces benzoate and phenyl radicals which initiate chains. George and Robertson have studied the kinetics and have found a monomolar order for the catalysed oxidation of tetralin and by analogy suggest a chain mechanism similar to the benzoyl peroxide reaction. A bimolecular rate has also been found for some of the peroxide catalysed oxidation. In the absence of sufficient kinetic data heats of reaction values have been utilised to formulate probable reaction mechanism. The oxidation of the olefins, ethyl linoleate, ethyl linolenate and methyl oleate, have been shown to follow a chain mechanism. Bolland and Gee consider that the oxidation of ethyl linoleate is accompanied by a double bond displacement. It is suggested that one of the chain carriers is the free radical R.CH = CH.CH = CH.R′, which has other forms of resonance configurations and forms isomeric peroxide radical with O_2. Though the chain mechanism is considered to be the same, squalene behaves differently from the other olefines inasmuch as the peroxide yield which is smaller at the earlier stages of reaction appears to be unrelated to the extent of oxidation. It is evident that further data are necessary for a fuller understanding of the detailed mechanism. The oxidation of rubber, hydrocarbon fuel, coal, etc., have been considered. The points of oxygen attack; the nature of the peroxide, structural influences on the reaction and scission products are the main topics of discussion. Peroxide formation has been established and a similar mechanism has been suggested. In the oxidation of carbon, a complex containing active oxygen has been postulated and the process is suggested to be similar to organic peroxide formation. In the absence of complete data, however, most of the conclusions have to be tentative.

Oxidation of the hydrocarbon in the gas phase forms the subject of discussion in the third section. The chemical products, the kinetics and the reaction chains and mechanism in oxidation processes, during detonation, explosion and slow combustion producing cool flames, have been considered under this section. Spectroscopic methods for detection and analysis of the products of the reaction have been applied. Knock in an internal combustion engine is caused by a high velocity explosion wave. An active oxidation catalyst, probably a peroxide capable of setting up reaction chains, is considered to be generated, but the exact nature and method of production of the knock-producing entities are not very definite. Prettre and Perrin are of the opinion that the production of carbon monoxide and hydrogen by the catalytic oxidation of methane is not a direct reaction. They used a catalyst containing 12 per cent. nickel and found that the exit gases always contained CH_4, CO_2 and H_2O. They concluded that the initial oxidation of methane produces CO_2 and H_2O, which through further endothermic reactions with the residual methane, give CO and H_2. Topps and Townend have investigated the light emission during ignition of mixture of oxygen with ether and acetaldehyde. A technique has been described for the spectroscopic analysis of the luminescence. Depending on experimental conditions, a cool flame, produced at lower temperature and a more intense blue flame are observed. The spectrum of the cool flame is identical with the fluorescent bands of formaldehyde excited under radiations. The exact mechanism of the process is not clear as chemical analysis does not give detectable quantities of formaldehyde. The measured temperature of cool flames is not sufficient for a purely thermal excitation of formaldehyde molecules. Calculation from intensity measurements with acetyldehyde gave a very low efficiency for the emission process. It has been suggested that methyl alcohol, whose oxidation under certain conditions gives an identical spectrum, might be a factor in the production of cool flame of acetaldehyde, but experimental data are not sufficient for a definite conclusion.

Short-lived radicals and free atoms play an important part in combustion reactions. Oxygen atoms and NO react to give a continuous emission spectra with its maximum in the yellow-green and thus afford a method for the detection of oxygen atoms in flames. The presence of oxygen atoms has been utilised in various chain mechanisms put forward to explain combustion reactions. An example is afforded in the oxidation of SO_2 in combustion flames studied by Dooley and Wittingham. SO_3 is formed in flames by the oxidation of SO_2. A technique for the direct determination of SO_3 is described. Dew points were determined by an electrical conductivity method by streaming the gaseous mixture across a cooled glass vessel in which two thermocouples were fixed and by measuring the increase in conductivity consequent on the deposition of the H_2SO_4 mist. The reaction is explained by the intermediate formation of H_2S, CS_2 and other sulphur compounds which generate CS and CO radicals. These radicals by chain reactions

evolve oxygen atoms which ultimately produce SO_3 by interaction with SO_2.

Combustion reactions in fuel beds have been investigated by Thring. Deep fuel beds are favoured in technical practice to avoid mechanical lifting of particles. Considerable amounts of CO are consequently produced by the reduction of CO_2 and excess air has to be fed in to burn the CO. Complete combustion without much excess air and a CO_2 content approximating 20 per cent. in the combustion gases from coke, are the ideal conditions for maximum temperature in a furnace. An experimental furnace is described in which the air stream is directed downwards on the surface of the fuel bed, by means of a nozzle of variable aperture. By the down jet combustion method, the CO_2 content of the issuing gases is raised and a higher furnace temperature is attained. The various factors connected with this new technique in furnace design are discussed. The oxidation of yellow phosphorus and the photochemical oxidation of formaldehyde are dealt with in the last two papers. The glow accompanying the slow oxidation of phosphorus is a cold flame. Hydrocarbons act as poisons by using up the atomic oxygen required for the chain propagation. The photochemical reaction between oxygen and formaldehyde at temperatures below those of the thermal reaction has been investigated.

P. B. G.

SCIENCE NOTES AND NEWS

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

A MEETING of the Governing Body of the Imperial Council of Agricultural Research was held in New Delhi on the 25th and 26th September 1946. The Hon'ble Dr. Rajendra Prasad, Member for Food and Agriculture, was in the Chair. Among those who attended were Provincial Ministers of Agriculture—Mr. M. P. Patil from Bombay, Mr. N. A. Sherwani from the U.P., Sardar Swaran Singh from the Punjab, Dr. Syed Mahmud from Bihar, Sri Nityananda Kanungo from Orissa and Dr. Rameshwar Agnibhoj from the C.P.

Ten schemes of national importance on agriculture and twelve on animal husbandry were sanctioned. It was also decided that the name of the *Imperial Council of Agricultrual Research* should be altered to *Indian Council of Agricultural Research*. The procedure for shortening the period of 19 months taken at present for sanctioning schemes to 7 months was also approved. The Governing Body also approved the scheme for bringing out Urdu and Hindi editions of the Council's popular Journal *Indian Farming*.

Agricultural Schemes

(1) Tests with D.D.T., 666 and allied insecticides, at the I.V.R.I., Madras, Bombay, U.P. and the Punjab. (2) Co-operative experiments on fungicidal sprays. (3) Insect pests of paddy. (4) Contribution to the Indian Botanical Society. (5*a*) Improvement of pastures (Punjab). (*b*) Improvement of pastures (Bengal). (6) Manurial experiments on paddy lands. (7) Nitrogen fixation in soils. (8) Rice research scheme. (9) Physiology of pulses. (10) Medicinal plants.

Animal Husbandry Schemes

(1) Effect of humid climate on cattle. (2) Standardisation of ration for ryots' cattle. (3) Bacteriological standards for market milk. (4) Dairy technology. (5) Sheep (Damani) breeding. (6) Rapid and detailed determination of fat, etc., of milk. (7) Helminth parasites of poultry. (8) Sheep and goat disease. (9) Research on the biology of marine prawns. (10) Laboratory for wool analysis. (11) Disease Investigation Officer scheme. (12) Linoleic acid content of ghee.

The Twelfth Annual Meeting of the Indian Academy of Sciences is scheduled to be held at Allahabad from the 26th to 28th December 1946 jointly with the National Academy of Sciences, Allahabad.

Fuel Research Institute, Digwadih.—The Hon'ble Mr. C. H. Bhaba, Member for Works, Mines and Power in the Interim Government, laid the Foundation Stone of the Fuel Research Institute at Digwadih, Dhanbad, on Sunday, the 17th November 1946. Sir S. S. Bhatnagar, Director of Scientific and Industrial Research, welcomed the guests and Dr. J. W. Whitaker, Director of the Institute, extended the vote of thanks.

ERRATA

Volume 15, No. 8, August 1946, page 234, lines 16-18 (Note entitled "Chromosome Numbers in Bambuseæ"): *For* "it is found that mostly all of them come under $n = 35$ and $2n = 70$, while Riccharia groups with the basic number $n = 12$.", *read* "it is found that mostly all of them come under either $2n = 48$ or $2n = 72$ chromosome groups with the basic number $n = 12$."

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NEW CONCEPTS OF CRYSTAL STRUCTURE

AS is well known, the theory of crystal structure was worked out by Sohncke, Schoenflies and Federov in the 19th century on a purely geometric basis long before the discovery of the diffraction of X-rays by crystals opened up the possibility of the physical exploration of their atomic structure. The results of the geometric theory are embodied in the statement that any crystal must belong to one of the 230 possible space-groups, which in their turn are derivable from the 32 possible point-groups or symmetry classes to which a crystal can be assigned; these symmetry classes can be grouped together so as to yield the well-known classification of crystals into six (or seven) divisions. The theory of space-groups rests on the premise that the structure of a crystal exhibits the translational symmetry of a space-lattice or three-dimensional network of equally spaced points; a number of such lattices similar and similarly situated but not coincident interpenetrate each other, and the structure of the crystal is obtained by locating a set of atoms of the same kind at all the points of each such lattice. The enumeration of the possible space-groups is based on a consideration of the various types of symmetry which could be exhibited by such a structure. In passing from the point-groups to the space-groups, some additional types of symmetry become possible, *viz.*, glide-plane reflexions and screw-axes, the effect of which is to multiply the number of lattices which are occupied by atoms of the same kind and to locate these atoms within the unit cell of the structure at equal intervals which are integral submultiples of the lattice spacings. The theory of space-groups is complete in itself and its conclusions are fully borne out by the results of the X-ray investigations made with crystals. The determination of the space-group to which a crystal belongs is possible by X-ray study, the so-called absent reflexions giving the clue to the existence of glide-plane reflexions and screw-axes as elements in the symmetry of the structure. Indeed, assignment in this manner of the crystal to the space-group to which it belongs is a necessary step in the task of completely elucidating its structure.

While the complete generality and utility of the theory of space-groups are unquestionable, the nature of the approach which it makes to the subject of crystal structure is purely formal and geometric, and hence the theory cannot take us far towards a physical understanding of the facts of crystal structure. It

only tells us what combinations of the various elements of symmetry are possible and the results of such combination, but is not concerned with the reasons for their appearance. A characteristic feature of the theory of space-groups is the introduction, in all except some special cases, of undetermined parameters in the description which it affords of crystal structure. The appearance of unknown quantities in the description of a structure characterised by perfect order and symmetry must be considered a disturbing and unsatisfactory feature and is an indication that the foundations of the theory have not been laid deeply enough in the groundwork of physical reality.

AN ALTERNATIVE APPROACH

It is proposed in the following to put forward tentatively a concept of crystal structure which, while it is radically different from that forming the basis of the theory of space-groups, does not come into conflict with the results of that theory, but on the other hand, affords a physical interpretation of them, and also explains many facts known regarding the structure of crystals which have hitherto remained without adequate explanation. The concept proposed may be stated in the form of four propositions or postulates.

I. All the atoms in a crystal whether of the same or of different kind are located at the points of a common space-lattice: but not all the points of the lattice are necessarily occupied.

II. The locations of the atoms at the points of the common space-lattice with respect to each other are determined by fixed rules derived from their mutual affinities.

III. The unit of the structure which results from the grouping of the atoms around each other at the points of the common space-lattice is of the same species as the cells of that lattice, but its dimensions are integral multiples of the cell dimensions.

IV. The valence directions in the crystal structure obey the law of rational indices.

We shall now proceed to comment upon each of these postulates in turn, offering some sort of justification for each of them and pointing out their interrelations. The first postulate contains the kernel of the proposed new concept of crystal structure. Various considerations may be urged in favour of its acceptance. In the first place, it removes all uncertainty or arbitrariness in the specification of crystal structure, and has thus a purely philosophical or *a priori* justification. Secondly, it may be remarked that for a variety of atoms of different kinds to settle down to form the regular arrangement in space which we call a crystal, it is clearly necessary that they should all take up places in a common plan and the simplest assumption which we could make regarding the nature of this plan is that it is a three-dimensional network or space-lattice, the points of which provide locations for all the atoms. It is also evident that the existence of such a plan does not necessitate that all the points in the lattice should be filled. *Per contra*, the existence of unfilled places would, in general, be necessary if atoms of different kinds and, therefore, of different sizes are all to be accommodated in the same lattice.

Our second postulate scarcely needs detailed justification. The atomic interactions would obviously determine the manner in which the atoms would take up positions in the postulated common space-lattice, and unless these interactions are of such a nature that they result in specific types of grouping of atoms of the same kind or different kinds about each other, anything like the regular order characteristic of a crystal would clearly be impossible.

Our third postulate may be regarded as consequential on the first two. If we postulate definite types of grouping of the atoms about each other in a common space-lattice, the final result of such grouping should exhibit the various types of symmetry shown to be possible by the theory of space-groups. In the first place, the structure would repeat itself in three dimensions at regular intervals, which are integral multiples of the spacing of the primitive lattice. In other words, the resulting structure would be such that the atomic co-ordinates in the unit of the structure would all be integral multiples of the spacing of the primitive common lattice, and, therefore, either rational sub-multiples or rational fractions of the dimensions of the structural unit. Thus, our postulates would lead naturally to the appearance in all cases of a translational symmetry in the structure of the crystal and also in appropriate special cases, to the types of symmetry recognised in the space-group theory as arising from glide-plane reflexions or screw-axes. But the existence of rational relationships between the atomic co-ordinates and the dimensions of the structural units is a general consequence of our postulates and is not restricted to such special cases.

Our fourth postulate is not an independent one but is merely consequential on our first and second postulates. But it appeared worthwhile to put it forward as a distinct postulate because of its obvious importance in relation to the views of crystal structure here considered, and also because it appears possible to find an independent justification for it. The idea of a directed valence is a fundamental notion of chemistry and is stressed in organic chemistry with reference to the so-called "tetrahedral" valence directions of the carbon and silicon atoms. But one has only to recall cases like cyclo-propane or cyclo-butane to stress the fact that even in saturated carbon compounds, the valences of carbon are not necessarily tetrahedral and that their directions are influenced by the structure. Thus, if the notion of valency has any meaning at all in relation to the crystalline state of matter, we may expect to find the directions in which it is exerted, in other words, the directions of the lines joining neighbouring atoms to bear some simple and specific relations to the structure of the crystal. If such relationships exist, their nature should be of the law of rational indices which one naturally regards as the most fundamental fact of crystal architecture. Thus, if our fourth postulate is regarded as having an

independent theoretical justification, our first postulate would be a consequence of it, and *vice versa*.

Lest it be thought that our present approach to the theory of crystal structure is hypothetical and speculative, it may be pointed out that a great many inorganic crystals, both of an elementary and of a compound nature, whose structures have been determined with some assurance of finality may be described in terms of our present concepts. Indeed, all crystals in which the atomic co-ordinates have been found to be simply related to the lattice spacings, either as a rational sub-multiple or as a rational fraction thereof fall naturally into the present scheme of thought. Many such structures may be found on an examination of the tabulated results of X-ray analysis. Particularly significant are those cases in which atomic locations of this kind are not demanded by the results of space-group theory.

Some Outstanding Questions

Before concluding, it may be worthwhile to reply briefly to some criticisms which may be urged against the present point of view. The most likely criticism that might be urged is that there are apparently well-attested cases of crystals in which the atomic co-ordinates are *not* expressible as rational sub-multiples or rational fractions of the structural cell-dimensions. The answer to this criticism is that such cases deserve careful re-examination with regard to the facts or their interpretation. The atomic co-ordinates here considered are the positions of the atomic nucleii, while the co-ordinates determined from the study of X-ray reflexion-intensity represent the optical centres of the electronic clouds surrounding the nucleii. If the electronic clouds are not spherically symmetrical, the locations determined from the X-ray intensities would not necessarily be those of the atomic nucleii. Another possible source of error in the X-ray studies is the thermal agitation of the atoms which may be considerable and not necessarily symmetrical about the nuclear positions. Not until these and other possible sources of error in the X-ray studies are carefully considered and eliminated in various simple cases which appear to conflict with the present point of view could their evidence be considered to outweigh the significance of the large number of cases in which it does fit with the facts and offers an intelligible explanation of them.

C. V. Raman.

AN INSTITUTE OF SCIENTIFIC INFORMATION FOR BRITAIN

On 8th July a discussion on "The Dissemination of Scientific Information to the General Public" was held at the Royal Institution, London, under the auspices of the Royal Society's Empire Scientific Conference and the British Association for the Advancement of Science. Sir Richard Gregory, F.R.S., who was for many years Editor of *Nature*, was in the Chair, and papers were read by Sir Henry Dale, O.M., F.R.S., late President of the Royal Society, Mr. Ritchie Calder of the *News Chronicle*, representing the profession of journalism, Dr. O. Howarth of the British Association for the Advancement of Science, Commander Ian Cox of the B.B.C., and Mr. Paul Rotha, representing the film industry.

The media by means of which scientific information is disseminated to the general public were reviewed and it was stressed how greatly the war has stimulated a public interest in science—an interest philosophically optimistic and largely vocational. But the specialization of science and the complexity of its organization are baffling to the public, while scientists have a caution and conservatism about publicity.

In view of these considerations the need is apparent for a link between the public and the man of science. It was suggested that this link should take the form of an Institute of Scientific Information, the function of which would be :—

(*a*) To keep a record of all scientific research in Great Britain, in the Commonwealth and in the world as a whole.

(*b*) To obtain access to scientists in order to secure the latest information for issue to the Press or B.B.C. and to refer to the proper scientific authority any story the Press or B.B.C. might bring forward.

(*c*) To supply to the Press and other media lists of learned and technical points in pure and applied science.

(*d*) To keep the Press and B.B.C. supplied with official scientific releases.

(*e*) To give advice and make recommendations on all matters connected with the publicity of science. The producers of films or broadcasts and the organizers of exhibitions or museums would look to the Institute to help them with advice and co-operation.

It was suggested that the Institute would be endowed partly from public and partly from independent sources. It would be called upon to issue pronouncements on controversial subjects and would be judged by the sincerity with which it reacted to varying interpretations of the social function of science.

—*Courtesy of "Monthly Science News"*, 1946, No. 9, p. 60.

OBITUARY

PANDIT MADAN MOHAN MALVIYA

MALVIAJI'S passing away on November 12, at the ripe old age of 85 amid unprecedented scenes of an almost worshipful homage in which over a hundred thousand joined, dropped the curtain over a long and remarkable career consecrated to the Nation's service. Born in a pious Brahmin family with no advantage to start, Malviyaji began life as a teacher with a very early foreshadowing of his gifts for a sustained and inspiring utterance in any cause with a constructive and humanitarian appeal; then a distinguished journalist and leading figure, first in the U.P. (1902-12), and in the Imperial Legislature, Delhi, until 1920; a legal luminary, giving up a lucrative practice for 'whole time' public work; an almost single-handed leader in the campaign to secure for the *Nagari* character its rightful status; Founder-President of the All-India Hindu *Mahasabha*, the *Seva Samiti* and a whole group of organisations designed to harness forces of an awakened religion for the country's service along political, social, cultural and economic channels; called four times to the Presidency of the Indian National Congress, in a way the very greatest gift in the hands of his people, Malviyaji will rank high amongst the illustrious builders of the Indian Nation.

The rich tributes paid by first rank leaders in diverse fields, especially the political, in this country and (some) outside, make it unnecessary to appraise here the latter, the most dominating aspect of Malviyaji's life-work. Ever steeped in the idealism and traditions of the Indian past and an unshakable faith in the greatness of its future, Malviyaji was not unaware of the chief weaknesses of the national position due, *e.g.*, to certain social evils and the extreme backwardness of the economic development. Characteristically enough, he strove to combat the former rather by mass appeal to reason and social conscience, than through legislation; for the latter, he appealed for popular enterprise and initiative and a broad-based State policy. His work on the Industrial Commission (1916-18) and his famous minute of dissent to its Report reveal markedly Malviyaji's ever-active spirit of constructive criticism and realistic outlook.

While any of these lines of work would have sufficed for "a life's reputation", Malviyaji's claim for a permanent place in the recollection of his country is his monumental work as the Founder, for twenty-one years the Vice-Chancellor, and last seven years the Rector (in the late Dr. Besant's words, "the very heart and soul") of the Benares Hindu University, spread over a campus of 1,300 acres, and adjacent to the holy *Kashi* of immemorial and hoary traditions; this was the first teaching and the residential University in the country, with Rs. 105 lakhs collected from Princes and public—a unique tribute to Malviyaji's indomitable will and the people's trust. The University was "established to preserve and popularise all that was good and great in the ancient civilisation of India and, at the same time, to impart instruction along lines of the best of modern Universities". Here, more than anywhere else in the motherland, will abide for ever in imperishable memory, the spirit of this *Rishi* and a maker of modern India.

S. S. JOSHI.

SIR JAMES HOPWOOD JEANS, O.M.

IT is with deep regret that we record the death, on 16th September, of SIR JAMES HOPWOOD JEANS, O.M., F.R.S., at the age of 69. Jeans was known throughout the world not only for his many original contributions to mathematical physics but also for his lucid expositions of science in books and articles intended for the general public. His academic career was a brilliant one, and among the positions he successively held were those of Professor of Applied Mathematics at Princeton (1905-9), Stokes Lecturer in Applied Mathematics at Cambridge (1910-12), and Professor of Astronomy in the Royal Institution. He held also many important offices and was at various times Secretary of the Royal Society (1919-29), President of the Royal Astronomical Society (1925-27), and President of the British Association for the Advancement of Science (1934). He was honoured by universities and societies throughout the world, and received among other awards, the Royal Medal of the Royal Society, the Gold Medal of the Royal Astronomical Society, and the Franklin Medal of the Franklin Institute.

One of Jeans' first major contributions to science was his confirmation of Lord Rayleigh's law for black-body radiation. In this field he quickly recognized the significance of Planck's quantum theory and used it skilfully to develop his own theories. He gave too, in 1903, the first rigorous proof of Maxwell's law for the distribution of velocities among the molecules of a gas. Although his work materially advanced many branches of physics, Jeans is most generally known for his cosmogonic work. His brilliant theories of the origins of the planets and their satellites and of the source of stellar radiation have gained wide, if not universal, acceptance. He will be remembered too for his philosophical interpretation of modern science. Though his philosophical theories have excited much controversy, they represent a courageous and carefully considered attempt to answer problems whose manifest difficulties have deterred most of his contemporaries. His death is a severe loss to British science, the more so as it comes at a time when the rapid advancement of science is creating so many urgent philosophical problems.

—(*Courtesy of "Endeavour"*, Oct. 1946, p. 154.)

PROBLEMS OF THE INDIAN COAL INDUSTRY*

ONE of the many striking paradoxes for which India is famous is her coal position. India produces over 30 million tons of coal per year and is the second largest producer of coal in the British Commonwealth. Yet, our industrial development has not progressed beyond one-twentieth of our capacity. We have extensive deposits of coal, but we have hardly touched even the outermost fringes of the numerous industries that are based on coal and its products, and that are essential for our national welfare and progress. We have only to look at the latest advances made in the field of coal industry in other countries to convince ourselves of the utter neglect we have meted out to this important mineral, which in its importance may be compared to food. Coal is as much a food for the maintenance of industrial life as food is the fuel for the sustenance of human life.

For efficient utilisation and conservation of coal, all progressive countries have adequate provision both for research and development. In England, the coal situation is so serious that the whole industry has been under critical examination. Particular attention has been directed to explore the possibilities of mechanisation of the mining methods. This is expected to give not only longer lease of life to the mines but it will surely lead to the quickening of the pace of production and to the amelioration of the social conditions of coal miners. The U.S.A. has now the lead in this direction, although it is admitted that the first mechanical devices were employed in Great Britain. They were abandoned because research work in England in the subject of Engineering did not keep pace with the rapid utilisation of coal for industrial purposes. The arguments that the British coal seams were not amenable to treatment by mechanical methods of an automatic character seem to be based on prejudice and recent American attempts to provide automatic mining methods in England seem to have been on the whole a success. It is not hard to imagine how much of the arduous and unpleasant labour could be saved in this country if only efforts are made to introduce mechanisation in the mining of coal in India. As labour is still available in India comparatively cheaper, it may not be considered as vitally important as yet, but we must look ahead and provide for mechanisation.

Perhaps a few words on the achievements of coal research may not be out of place on this occasion. Research investigations on the preparation, transportation and storage have yielded results of great importance to the coal industry. It has involved scientific work on sizing and grading, briquetting, coal breakage, wet washing, dry cleaning and gravity washing under dense media and such subjects as control of fires, dewatering and drying, dustproofing, coal storage and physical structure of coals.

The Regional Coke Research Committee in Great Britain have mainly addressed themselves to research investigations leading to increasing the flexibility of the coking process with a view to using inferior coals for the purpose of conserving the high grade coal resources and to controlling the products according to demand. This has led to several new processes such as the carbonisation of various single and blended coals and to the modification of the carbonisation plant itself. Mention must be made here specially of the plant known as the Narrow Brick Retort. Considerable investigations have been carried out in the U.K. on the chemical conversion of coal, tar and coal products. Of these, gasification, the hydrogenation and cracking of tars and oils and the Fischer-Tropsch Process for the production of synthetic petroleum are of special importance. The wide range of investigations covered by the various Fuel Research Laboratories include geological, physical and chemical survey of coal seams, coal cleaning and preparation of coal for the market; low and high temperature carbonisation; complete gasification of coal; production of hydrogen from coal and coke; and fundamental research comprising of solvent extraction, coalification, petrographical classification, study of porosity and surface, particle size determinations, X-ray diffraction, radiography, reflectivity, assays, thermal distillations, chromatographic separation, spectroscopic examination, etc.

The Coal Division of the Bureau of Mines in U.S.A. has been responsible for comprehensive investigations on coal in all its aspects from production to utilisation. Perhaps, the most notable achievements of America in this field are the oxidation products of coal. Numerous organic acids have been obtained by the oxidation of coal which are finding increasing importance in plastics, dyes and drugs industries. Mention must be made also of researches which have enabled producer-gas manufacture from inferior coals, development of smokeless burners for residential buildings, new coal-fired steam locomotives to compete with diesel locomotives, pulverised and colloidal fuels, complete gasification of coal, etc. In the coking industry perhaps the most outstanding work is that of Messrs. Koppers Company of New Jersey. They have introduced such features in their plant for producing coke which makes the once old hot and uncomfortable process, now a thing of joy. All the operations are automatically carried out in an air-conditioned basement; and with the aid of just a few men, large quantities of coke are produced from coal and the bye-products also are automatically collected. Intensely original and fascinating are the Russian investigations on underground gasification of coal. From the point of view of saving initial costs and the economic production of gas these investigations have attracted world-wide attention and the very idea underlying underground gasification, which makes use of the earth itself as a huge retort, which is heated by the fire that is produced gratis inside its bowels, is indeed revolutionary. It is not necessary for me to stress the significance of this development to this country where underground destruction of coal

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* Extracts from the Opening Address delivered by Prof. Sir Shanti Swarup Bhatnagar, Director, Scientific and Industrial Research, on the occasion of the Foundation Stone Laying Ceremony of the Fuel Research Institute, Digwadih—Dhanbad, on 17th November 1946.

by spontaneous fires has already resulted in colossal losses.

It has been estimated that the life of the reserves of Indian coals are as follows: All good quality coals—120 years; coking coal of good quality—about 62 years; non-coking coal of good quality—about 100 years. It will be seen that the position of the coking coal reserves in India is poor, especially in view of the fact that very large reserves of 'iron ore' of high grade are available in the country. Within 150 miles of the coalfields alone the iron ore reserves exceed 3,000 million tons. It is obvious that our reserves of coal are short of our needs. At the present rate of output and consumption and at the present rate of mining, the reserves in India can hardly last more than fifty years unless more efficient utilisation and conservation of the coking coals are practised.

Next in importanse are all grades of coal of high volatile content and of the non-metallurgical type. These coals, apart from steam generation, have very special uses, such as carbonisation, bye-products recovery, hydrogenation or synthetic production of oils, gas manufacture, chemical industry and so on. The coal-tar distillation industry, sadly neglected in the past, is an absolute necessity to-day. The great varieties of oils, high explosives, dyes, drugs and pharmaceuticals, plastics, insecticides, germicides, rubber, etc., which can be derived from coal-tar, are all essential for national progress and well-being. Great losses are also resulting from the primitive methods of soft coke or domestic coke manufacture and research must help in solving this problem.

Another source of loss of coal is during the mining operations. During mining a part of the coal is small or "slack" coal and as such it has no market in India. Utilisation of this coal with the help of modern scientific and technical methods of combustion and briquetting would avert this great waste. Many of the so-called inferior grades of coal of high ash content, of which India possesses a large and 'fairly unlimited' reserves are also not workable at present. These coals can be upgraded and efficiently utilised through research and development of appliances.

An important feature of our coal industry is the lack of any standards for specifications. It is not generally recognised that this lack of standards results in wasteful mining methods and in consequent loss of large reserves of coal. The present methods of certifying coals on the basis of the specifications of the Indian Coal Grading Board has often led to selective mining of seams resulting in serious loss of coal. Stowing and utilisation of the inferior qualities of coal are the only measures to check these wasteful methods of mining resulting in the loss of our irreparable national asset.

The 'by-products' industry, which is still in a primitive state in India, must also be developed for the future prosperity of the fuel industry and the nation. All these can only be achieved through co-ordinated and intensive scientific research. The first notable step taken in this direction was the constitution of a Fuel Research Committee in 1940 under the auspices of the Board of Scientific and Industrial Research with the late Dr. H. K. Sen as Chairman. Sir Cyril Fox and Mr. Farquhar succeeded Dr. Sen as Chairman. During these six years the Fuel Research Committee has been responsible for initiating several research schemes bearing on Indian coal industry, the most important of which are the washability of Indian coals under the guidance of Dr. Charles Forrester of the Indian School of Mines; the coking and blending of coals under the joint auspices of Mr. Farquhar of the Tata Iron and Steel Co. and the Council; and the carbonisation and desulfurisation of Indian coals under the guidance of Dr. B. C. Guha and Dr. J. K. Chowdhury respectively. The most important activity of this Committee has, however, been its concerted effort to bring about a central Fuel Research Station for India which will carry out comprehensive research on all aspects of fuels. The Council of Scientific and Industrial Research accepted the recommendations of the Fuel Research Committee in respect of the urgent need for a National Fuel Research Institute and appointed a local planning committee to draw up detailed plans for the proposed Institute. Of this committee, the leading lights are all present here. Our special thanks are due to Mr. Kirby, Chairman of the Local Planning Committee, Dewan Bahadur Thacker, acting Chairman of the Fuel Research Committee, and Dr. Charles Forrester, Principal, Indian School of Mines. We miss Mr. Farquhar and Mr. Wilson-Haigh, who are on leave, and who contributed much towards the success of our earlier efforts. The Fuel Research Committee also appointed a Site Selection Committee, who after much careful thought and deliberation, chose the present site. Here the superior rights of about 100 acres of land were very generously donated to the Council by the Raja Shiva Prasad Singh Bahadur of Jharia for the construction of the Fuel Research Institute.

The Fuel Research Institute of India when completed will cover all aspects of research both fundamental and applied, on solid, liquid and gaseous fuels, although for the present the activities of the Institute must necessarily be confined to a large extent to solid fuels and coal in particular. The work has been divided into a short-term programme and a long-term programme, and this arrangement is only in accordance with the urgent and future needs of the country in respect of fuels.

The short-term programme includes:

(1) *Rip Survey.*—A quick physical and chemical survey of Indian coals with a definite time limit, say two to three years, involving the determination of proximate analysis, coking properties, total sulfur, calorific value, carbon and hydrogen contents and washability of the major producing coal seams.

(2) *Washability Tests.*—These tests will be carried out on full-scale samples from seams with a view to improving ash contents of coals of coking quality and for separating coking from non-coking coal in the same seams.

(3) *The Coking and Blending of Coals.*—Laboratory, medium and full-scale tests (in co-operation with the industry) on some selected coal seams with a view to immediate exploitation and examination of the reactivity of coke.

(4) *Low Temperature Carbonisation.*—Laboratory investigation for survey and

full-scale tests on some selected seams, again with a view of immediate exploitation and selection of some plants which have already proved successful on an industrial scale.

(5) *Gasification.*—Investigation of alternative supply of fuel for the immediate manufacture of hydrogen for ammonia synthesis and for complete gasification of inferior grade non-coking coals for the manufacture of industrial gases. This is a subject of great interest and has been rather neglected in India.

(6) *Investigations on Road Tar.*—In view of the post-war road building programme in India, this research will be undertaken early.

The long-term programme will include:—

(1) Detailed survey of Indian coals for the determination of all the physical and chemical properties of coals, including agglutinating value, swelling properties, washability, calorific value; and development of specification tests.

(2) Investigations on carbonisation and coking properties.

(3) Deterioration of coal on storage and weathering.

(4) Researches on de-ashing and preparation of coal for the market.

(5) Researches on the nature of by-products of low and high temperature carbonisation with a view of their utilisation for the plastics, dyestuffs, drugs and pharmaceuticals, liquid fuels, lubricants and grease industries.

(6) Briquetting.

(8) Hydrogenation.

(9) Oxidation of coal for the production of dyes, plastics and allied substances.

(10) Liquid, gaseous and wood fuels.

(11) Establishment of a Central Fuel Research Library.

(12) Fundamental Research in Fuels.

All these proposed investigations stress the importance of coal as fuel and as a valuable source of chemicals for industry. I must, however, assure you all that the National Fuel Research Institute will not confine its activities to research on coal only. In fact, investigations on other fuels, such as for instance, mineral oils, gaseous fuels, colloidal fuels, etc., will form an important part of the functions of the Institute. In this connection, I would like to mention the importance of molasses-alcohol, which is a basic industry of India and which has great potentialities as an industrial fuel. The present estimated production of alcohol in India is in the neighbourhood of 22 million gallons, and during the war, when petrol was in acute short-supply, molasses alcohol retrieved the position and it was successfully used as fuel in internal combustion engines in admixture with petrol. Investigations bearing on these aspects of all fuels besides coal, will certainly engage the attention of the Fuel Research Institute.

Research alone will not solve all our problems. State measures to control and conserve production and utilisation of coal on lines likely to promote the interests of the industry are equally important. The necessity of such measures was realised sufficiently long ago, and the Government set up Inquiry Committees twice in the last decade. These committees had formulated many far-reaching recommendations but the indifference of the authorities cold-storaged the recommendations. Many of our problems would, by now, have been minimised if only the people who held authority then had the foresight to see the immensity of the problems and had acted on the recommendations. During the war, the problems assumed alarming proportions, and Sir Ardeshir Dalal on taking over the Planning and Development portfolio appointed the now well-known Indian Coalfields Committee under the chairmanship of Mr. K. C. Mahindra to review in detail the Indian coal position and to suggest ways and means of improving the coal industry. The Mahindra Committee have now submitted a useful report. They have brought out the importance of nationalisation of the coal industry in India and of setting up a separate Department of Fuel and Power and also of a National Fuel Board vested with powers to control production, distribution and utilisation of coal in India. The Committee have also stressed the importance of technical research on coal and have recommended the setting up of three Research Sub-Stations in the Raniganj, Bokaro and C.P. coalfields, in addition to the Central Research Institute. Another important recommendation of this Committee is that the cost of fuel research should be shared by Government and Industry and a cess of one pice per ton of coal despatched should be levied for this purpose. Similar recommendations were made earlier by the Council of Scientific and Industrial Research and the Sir Shanmukham Chetty Committee.

SOLAR SPECTRUM LINE INTENSITIES

DR. M. MINNAERT, of Utrecht, Holland, temporarily at Yerkes Observatory, described work now going on to compile a catalogue of the intensities of the Fraunhofer lines in the solar spectrum. Just before the war, the Utrecht Observatory published the *Photometric Atlas of the Solar Spectrum*, giving a graphic record of the intensity distribution in all the Fraunhofer lines. The new catalogue, compiled from the atlas, is already complete for the red and infra-red regions.

—(*Courtesy of "Sky and Telescope,"* No. 61, *November* 1946, p. 7.)

DEVELOPMENT OF SCIENTIFIC MAN-POWER AND MATERIAL RESOURCES*

I HAD occasion to visit the scientific and technical institutions of the United Kingdom last summer; and I was impressed by the strenuous attempts that were being made there to develop the scientific man-power and resources to the limit of capacity. It is universally recognised that no expenditure of public funds can be too high which aims at training men of science in sufficient numbers for successful execution of the post-war plans of reconstruction. The United Kingdom has at its disposal to-day a force of 55,000 qualified scientists (scientists include technologists); it is estimated that the demand for scientists by 1955 will not be less than 90,000. Hence the universities are being pressed to undertake an expansion of the order of 80 per cent. within the first post-war decade. Besides, the existing university colleges at Nottingham, Southampton, Exeter, Hull and Leicester, are being helped to expand rapidly and earn full university status at an early date.

In India, I wish a similar guidance were given us by competent planning authorities regarding our need for trained scientific and technical personnel within the first post-war decade. Training in Science and Technology costs far more than training in humanities and liberal arts. Whatever may be the policy in advanced countries like England, a poor country like India cannot afford to dissipate her resources for training technical personnel for whom gainful employment is not ready at the end of the training. The Government of India have now in their possession a large number of reports on planned development of various industries which have been prepared by the technical panels of the defunct Planning Department. I also understand that the Departments of Communications, Power and Mines have prepared accurate surveys of our present position regarding power, fuel, transport and irrigation. They have also made tentative suggestions perhaps too modest in their scope, regarding targets of development of these resources which may be attained in the course of five years. Governments, everywhere, in periods of transition, have to shoulder responsibilities and bear burdens which appear almost too heavy. It is a good sign of the times, that in spite of the sombre picture which is now blocking their vision, there is a general realisation among our leaders of the fact that the great issues on which our national future depends are at least as much economic as political; and we welcome the appointment of a Planning Advisory Board by the Central Government which will digest the valuable material which have been already collected and recommend at an early date to Government concrete projects for execution as integral parts of a well-planned developmental programme. I hope that the Planning Advisory Board will examine carefully the question of resource development in relation to availability of technical personnel, and give us the country's probable requirement of such man-power in the course of next ten years. I feel that we may also render Government a timely aid at this juncture. It may not be difficult, if all the members of our Association take up the work seriously to make a complete survey of the technical personnel that already exist in the country. Such a survey may give useful information regarding the wastage of such man-power, and also a factual appreciation of their efficiency in the creation of national wealth.

Capitalism *vs.* Technocracy

The National Planning Committee recommended long ago that in a free democratic India, the Defence industries, the key industries and the public utilities must be owned, (or in exceptional cases controlled), by the State. It is probable that all planning for resource development will be shaped by this ideal. State ownership inevitably means management of an industry or a utility by technicians who have proved their capacity for business administration. In India owner-capitalists have up-till now formed the *core of business management*. But even in countries which have retained their capitalistic economic structure, James Burnham has brought out fairly convincing arguments to show, that capitalism is rapidly changing into a managerial society. The administration of the many limited liability concerns in India are even now really vested in managing agents. It is necessary, therefore, that Technical Colleges should include provision for management studies, so that technical men who aspire to positions of senior administrators and engineer-managers may acquire early in their career all available knowledge relating to industrial organisation and efficiency audit.

The Human Angle

But this is not enough. All planning centres round the idea of human betterment and increase in human happiness. We hope that under the dynamic leadership of a National Government, human nature in India itself would enter upon a new phase of development. The placid pathetic contentment of a helpless and ignorant people, resigned to the vagaries of Fate, will be replaced by a vigorous and willing co-operative effort, which will harness modern knowledge and technology, and create a social and economic structure intended to give to every citizen a fuller and more satisfying life. The technician in India will have to realise that his mechanical efficiency will be of little avail in developing such a satisfying life, if the industrial world which employs his skill is governed with little wisdom. He should be imbued from early years with principles of social justice which rest on moral conceptions of human behaviour, so that when he attains positions of administrative responsibility, the happiness of men working

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* Excerpts from the Presidential Address delivered by Sir J. C. Ghosh, Director, Indian Institute of Science, to the Association of Principals of Technical Institutions (India), at Delhi, on Thursday, 21st November 1946.

with him becomes as weighty a consideration as the efficiency of the organisation which he is handling. He should remember that willing work in a congenial atmosphere elevates the stature of man; and that unwilling work extracted from a man tied to a machine is really a form of slave-driving. His education should open a window in his mind through which he can see visions of what science allied to morality can do for the human race.

I, therefore, cannot too strongly recommend for inclusion in the curriculum of higher technological education, those branches of humanities which will make the technologist a better citizen and a better administrator.

In conclusion, may I suggest that sometimes in their leisure hours, men of science and technology in India ponder over the following significant observation of the Dean of Canterbury, and cogitate how Indian masses can be galvanised into similar life:—"The strength of Soviet Russia which confounded the Fascist armies and astounded the world, the reason which made such miracle possible, springs from a twin source—the one moral and the other scientific. These two are really one. Science is based on truth of things and forces. Morality is based on truth underlying human beings and their actions. Russia's secret weapon is the weapon of science applied not for the profit of the few but for the well-being of all. Her second secret weapon is the courage and limitless endurance of people who knew that they were defending with their lives, the new way of life which they had built."

CONSERVATION AND CONTROL OF WATER AND WATERWAYS*

INDIA is fortunate in her immense resources in water and in her widespread waterways. But at present, the bulk of this water runs in uncontrolled floods doing damage to life and property. The waterways, which should, if properly trained and regulated, afford extensive arteries of traffic for the very cheap transport of agricultural and industrial produce, are lying mostly neglected with the result that during certain times of the year they form isolated pockets of stagnating water favourable for the breeding of mosquitoes. Without the application of water on lands, where rainfall is short or unseasonable, there can be no further increase in the area under cultivation or in the crop yield. Without assured and regulated supplies of water, there can be no source of cheap power and, therefore, little prospect of the exploitation of our mineral wealth and industrial development on any considerable scale. Without a network of waterways available for inland navigation, the bulk of rural areas will remain cut off from the markets and centres of industries and other developments.

Water and waterways are, therefore, the basic sources of wealth and national well-being. The projects for the control and conservation of water for purposes of flood control, irrigation, navigation and power generation, will not only help in protecting the countryside from flood damage, in growing more food, in generating cheap electricity for industrial, agricultural and domestic uses, and in affording cheap means of transport of goods, but will also bring in substantial revenues to the State in the form of returns from irrigation, power and navigation, and in taxes and otherwise, which after paying the interest on capital charge and maintenance and operation expenses, will leave ample surpluses for utilisation on other nation-building activities such as education, public health, defence, etc.

But the productivity of a project for the harnessing of the water resources of a country should not be measured merely in terms of the direct revenues and net returns, but in terms of the resulting rise in standard of living of the people affected by that project, of the general increase in their wealth and well-being and in the resulting indirect returns to the State. The indirect benefits of such projects to the people and the State are indeed great. They would afford work on a mass-scale during construction and subsequent maintenance and operation. They would afford ever-increasing opportunities for work in the expansion of agriculture and in the new industries that will spring up as a result of the raw materials and cheap power made available by the project.

The large reservoirs formed for the storage of water will afford immense possibilities for fish culture and thus provide the much-needed protective foods for the masses.

The control, conservation and regulation of water for beneficial use, must, therefore, be our first concern in any scheme of national planning. The extent to which we can control and conserve our water resources will determine the extent of our national security, national well-being and national wealth. It will determine the standard of living of the common man.

WATER WEALTH OF RIVERS

On a rough calculation, the mean annual supply of water in our rivers appears to be of the order of 2·3 million cft. per second. Most of this supply is, however, concentrated in the monsoon months and except for the snow-fed rivers coming from the Himalayas, the bulk of the rivers run almost dry during the dry months. The mean annual consumption of water for agricultural purposes derived from the canals has been roughly figured out as 133,000 cft. per second. Possibly another 30,000 cft. per second is utilised for irrigation from wells. This means that less than 6 per cent. of the available water wealth in our rivers is being utilised and the balance of over 94 per cent. is running to waste in the sea and in the process doing incalculable damage to life and property through uncontrolled floods and

* Extracts from the Presidential Address deliverd by Rai Bahadur A. N. Khosla, I.S.E., Consulting Engineer with the Government of India and Chairman, Central Waterways, Irrigation and Navigation Commission, at the Seventeenth Annual Meeting of the Central Board of Irrigation, held on the 26th November 1946.

their aftermath of blocked drainages, stagnating pools and malaria mosquitoes. It is difficult to say offhand what proportion of this 94% of our available water wealth, which is at present running to waste, can be put to beneficial use; but there is no gainsaying the fact that a very substantial portion of it can be so utilised. If the utilisable, but so far unused, water potential is no more than one-third of the total, it will amount to five times the total quantity of water which is being used at present throughout the country. That is an indication of the immense scope for extension of irrigation and power development and of the vast magnitude of our problems and opportunities.

INDIA'S ACREAGE

The total area of India is just over 1,000 million acres, about half of which lies in Indian States. A little over a third of this is covered by forests, roads, railways, towns, factories, etc., and is, therefore, not available for cultivation. Of the remainder, about 400 million acres are generally under cultivation but over 250 million acres, either lie fallow or are uncultivated wastelands. The principal reason for such a large area lying undeveloped is no doubt the lack of irrigation facilities and in a number of cases the liability to floods. Of the 400 million acres which are now under cultivation, a substantial part gets but indifferent crops for lack of assured water supply. As an illustration of the increase in the out-turn of crops that results from irrigation, statistics show that in the U.P., Madras and the Punjab the out-turn of rice from irrigated areas is better by 30 per cent., 40 per cent. and 60 per cent. respectively than from unirrigated areas. Similar figures for wheat are 50 per cent. in Sind and U.P., 60 per cent. in the Punjab and N.W.F.P., and 150 per cent. in Bombay.

India has each year 70 million acres under irrigation from canals, tanks, wells, etc. This is the highest irrigated acreage in the world. Without this extensive irrigation vast areas, particularly in the Punjab and Sind where rainfall is between 4″ and 15″, would have remained barren wastes and no crops could grow with that scanty and uncertain rainfall. Our canals have a carrying capacity of about 400,000 cft. per second. The number of wells in the country runs into hundreds of thousands; but with all these spectacular figures, which have no parallel in the world, we are still a deficit area so far as food production is concerned.

DEVELOPMENT OF CHEAP HYDRO-ELECTRIC POWER

Our schemes of irrigation in the past, particularly in North India, were mainly confined to the diversion of available supplies in the river and were relatively cheap. Such supplies have, however, been almost entirely used up. Henceforth, our main hope of extension in irrigation will lie in the surplus supplies which can be stored during the monsoon months and released as required during the months of short supplies. Such irrigation projects may not be fully self-supporting if confined in their use to the single purpose of irrigation. But fortunately such projects lend themselves to multi-purpose development. The storage of supplies during floods will lead to flood control. The equalisation of supplies during the year by means of storage will make available considerably increased supplies throughout the year which can be utilised for increased perennial irrigation and for the development of cheap and perennial hydro-electric power.

Cheap power is our greatest need at the moment. It is needed for domestic purposes. It is needed for the manufacture of fertilisers and for agriculture. It is needed for industry. It is needed further to conserve our limited resources in high grade, particularly metallurgical coal, vast quantities of which are at present being used up in generating power for industry, locomotive power for railways and as domestic fuel—a great national waste considering how vital coal is to our industrial economy and national defence. Coal as a means of generating power is exhaustible. Water, or so-called white coal, is inexhaustible. Its use for power generation involves no drain on our natural resources and would release coal for use for other purposes of national importance.

Electricity will constitute a most important item of amenity in the life of our backward and neglected rural population. With electric light in the house, a farmer can use his spare time in reading and improving his mental equipment. With cheap electrical heating he can save cowdung for use as manure. He can save fuel-wood and thus help in conserving our forest wealth for more profitable and long-range exploitation. With cheap hydro-electric power he can set up small cottage industries which will bring him additional income and provide him occupation during the long periods of enforced idleness between crops. Our objective should be to carry the benefits of cheap water power on the basis of "service at cost" to every village and to every home somewhat after the model of Canada and Sweden, both of which countries owe their present industrial development, wealth and prosperity to water-power.

It has been said that the *per capita* use of electricity of a people is the measure of their prosperity and power in the economical, social and political spheres. This *per capita* consumption is 9·2 kilowatt hours in India, 906 in England, 1,470 in U.S.A., 3,510 in Canada, 1,944 in Switzerland, 3090 in Norway and 2,000 in Sweden. This is a good indication of our position as compared with some other countries in the world. We have a long way to go before we can catch up with them. But we are fortunate in that India has a very large power potential in her unused water resources. That potential has not been correctly evaluated. It was stated to be less than 5 million k.w. by Meyers in 1920. He based it mainly on the available minimum continuous supplies in the rivers. On a rough approximation, the water-power potential of India is likely to be well over 30 to 40 million kilowatts. Against this our existing water-power development has not yet passed the half million mark. That shows the immensity of the scope for development.

PROJECTS UNDER CONSIDERATION

The few projects now under consideration, namely, the Bhakra and Nangal in the Punjab, Nayar and Rihand in the U.P., Kosi in Nepal, Damodar in Bihar, Tista in Bengal, Mahanadi in Orissa, Machkund, Godavari and Tunga-

bhadra in Madras, will provide power to the extent of about 4 million kilowatts of which the Kosi Project alone may account for a million and a half. The power production and power potential of India in the world context is somewhat as follows :—

	Population million	Water power potential million	Water power developed K.W.	Developed as % age potential	Per capita of consumption of electrical energy all types units
U.S.A.	150·6	48·9	16·8	34	1470
Canada	11·3	29·5	7·1	24	3510
U.S.S.R.	170·5	100·7	22·4	22	?
U.K.	45·0	?	0·22	?	906
France	41·8	8·9	3·7	42	431
Germany	69·6	5·9	3·2	54	1240
Switzerland	4·3	4·5	3·0	67	1944
Sweden	6·5	7·5	2·0	27	1455
Norway	2·8	4·5	2·4	53	3090
India	400·0	30 to 40	0·5	1	9·2
China	500·0	?	?	?	?

I am just back from a visit to Sweden and Canada, the two countries where coal is scarce and whose power development is mainly confined to water-power. In Sweden generation is mainly in the north and load centres in the south. The power is transmitted to distances up to 400 miles at present and will extend to as much as 600 miles in their schemes of the future. Some 87 per cent. of the rural population of Sweden are served by electricity and 35 per cent. of the main railways have been electrified.

The benefits of the schemes of multipurpose development if carried out on a nationwide plan, will extend to all areas and to all inhabitants and should, therefore, be the biggest unifying factor between the various communities in the economic, social and political fields, and the most effective safeguard against fratricidal strifes.

Irrigation Research in U.S.A. and Canada

During my recent visit abroad I was struck by the tremendous expansion in irrigation research activities, particularly in U.S.A. and Canada. The strength of personnel has been almost doubled and large sums of money have been set aside for research. The research laboratories of the U.S.A. Bureau of Reclamation, Denver, are being moved ten miles outside to extensive grounds and newly designed buildings. with facilities for expansion. This expansion has taken place in all branches of research, hydraulic, cements, concrete and earth materials, hydraulic and electrical machinery, mechanical appliances, etc. A triaxial machine—perhaps one of the two or three in the world—has been set up there to make a direct study of the stresses in three dimensions. The research laboratories in Toronto are bringing out new, more efficient, and cheaper utility articles for the common man and producing new and improved designs of hydraulic machinery, construction equipment and better methods of construction. In Sweden researches are underway for high-tension long-distance transmissions upto 400,000 volts A.C. or D.C., but preferably D.C.

Research in India

It is gratifying to note that research activity in India is steadily on the increase. We have the Punjab Irrigation Research Institute, Indian Waterways Experiment Station, Poona, the Bengal River Research Institute, the U.P.. Madras and Bombay Research Stations. New Research Stations are being set up in Hyderabad and Mysore. Very soon we shall be making a start with the Central Waterways, Irrigation and Navigation Research Institute at Delhi, which will be comprehensive in its scope and deal with all aspects of the many problems connected with rivers, irrigation, navigation and allied developments.

Research has yielded rich dividends in other countries. I am convinced that with proper direction and co-ordination irrigation research in India will likewise produce results which will play a most useful part in our schemes of development. India leads the world in the science of irrigation engineering and in matters of distribution of water and assessment policies, but it must be recognised that in many fields of activity, particularly machinery and instruments, India has so far been content to live on the inventions and enterprise of others. With our network of research organisations the stage will have been set for India to contribute her share to the world peel of science and inventions.

Training Technical Personnel

At this stage, I would like to draw the attention of Members of the Board and of the administrators responsible for policy, to the acute shortage of technical personnel in the country. The planning, design and construction of the projects for the multipurpose development of our water resources will necessarily be spread over many years, possibly decades. They will be in operation ever after. The researches undertaken in connection with these developments will extend far into the future. To man these projects and researches during various stages, we shall need technical personnel by the hundred. It is most important, therefore, to lay down as early as possible, a definite policy to increase suitably the number of technical colleges in the country and also the output from each. The courses of studies and training to be imparted at these colleges require very careful consideration and planning. It will be necessary in the early stages to send abroad a number of qualified engineers with adequate experience of works in India for specialising in various aspects of our schemes of development. This specialisation should be so arranged that between them a particular batch of engineers may be in a position to handle all problems connected with a project through all stages of development. This training abroad will also need careful planning and precise instructions will have to be laid down for each set of individuals.

INFLUENCE OF THE FORM OF NITROGEN ON THE QUALITY AND OF QUANTITY "PITCH" IN DISTILLERY PRACTICE

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NITROGEN which is provided in different organic and inorganic forms, constitutes an essential nutrilite for the growth and functioning of yeasts. Although a few disputable claims have been made that yeasts are capable of fixing elementary nitrogen[1,2,3,4] it is generally accepted that the greater and the more substantial part of its nitrogen requirements, have to be met through a supply of assimilable forms of nitrogen which are covered by a wide range of the comparatively simple inorganic and the more complex organic compounds.

Lindner[5] has made a study of the various sources from which an yeast could obtain its requirements of nitrogen. He found that compounds with long hydrocarbon chains were assimilated with comparative ease as compared with the utilisation of ring compounds like histidine. More recently, Nielson[6] and Hartelius,[7] in the course of their comprehensive studies, have investigated the relative efficiency, of some 36 different amino-acids as sources of nitrogen for the growth of yeast; some of them individually and in particular combinations have been shown to exert a growth-promoting effect.

The pioneering studies of Hartelius,[6] Nielson[7] and Thorne,[8,9,10] on the relative value of amino-acids as sources of nitrogen for yeast, have revealed that:—

(1) they vary among themselves in their nutritive value,

(2) the nitrogen in amino-acids is taken up by yeast in the form of ammonia which is formed by decarboxylation,

(3) amino-acids in mixtures exhibit a growth-stimulating efficiency which is far greater than what might be expected if the effect were merely additive,

(4) some of the amino-acids when administered in minute amounts (*e.g.*, β-alanine, asparagine, aspartic acid, glutamic acid, lysine and arginine) are found to possess a stimulatory effect on yeast-growth,

(5) Yeasts differ among themselves with regard to their response to various amino-acids.

The alcohol-producing capacity or attenuative power of an yeast naturally depends upon the concentration of the zymase complex, whose content of the "pitch" would determine its overall efficiency. The elaboration of the zymase complex in yeast is intimately connected with its nitrogen metabolism. Sippel reported that the attenuative power is restored by the addition of soyabean flakes to the extent of 0·2 to 3·0 per cent.; this supplement resulted in a replenishment of the normal protein content of yeast which had decreased by about 10 per cent. Difficulties of attenuation and of harvesting of yeasts have been traced by Bishop and Whitely[11] to the low content of nitrogen in worts especially when strongly attenuating yeasts are employed.

The fall in the attenuating power of "pitches" in distillery practice, is a common occurrence in most of the Indian distilleries. This is mostly due to faulty and poor nutritional conditions under which the "pitch" is built up. One of the essential limiting nutrients is nitrogen. In view of the importance of this nutrilite in distillery practice, we have made a systematic study of the efficiency of different sources of nitrogen on the rate of growth, the extent of growth and the attenuating power of the resulting harvests of yeasts.

PART I. RATE AND EXTENT OF GROWTH

EXPERIMENTAL

In the present investigation seven sources of nitrogen have been tried, ammonium sulphate, urea, asparagine, wheat bran extract, proteolysed extracts of groundnut cake and the distillery

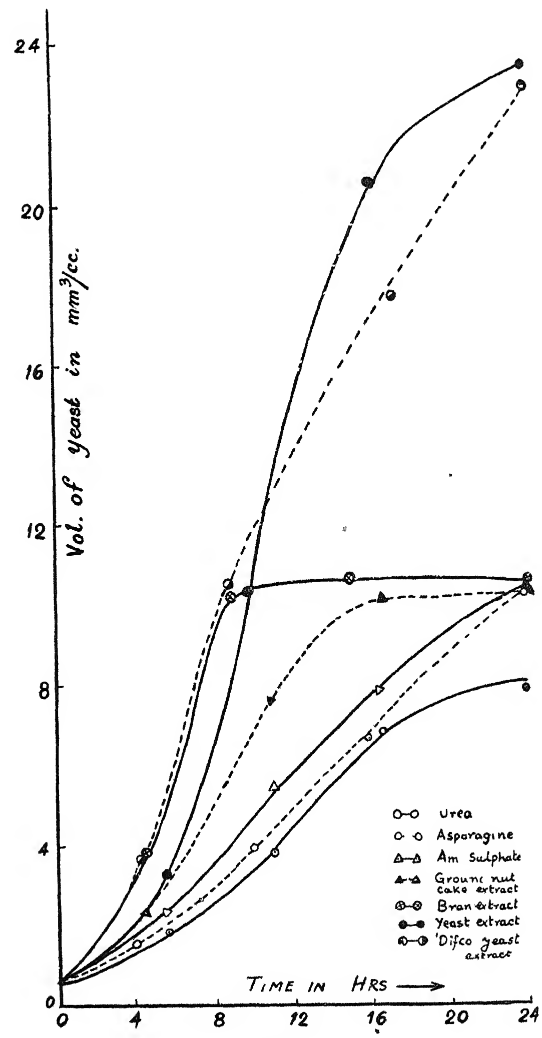

FIG. 1

yeast residues and "Difco" yeast extract. The basal medium employed in the course of these studies was similar in composition to the one used by de Souza and Sreenivasaya.[12] The organism investigated was a strain of distillery yeast developed in the section of Fermentation Technology, and the one which has proved eminently successful in yielding high concentration distillery washes. The nutrient solution was supplemented with different nitrogenous extracts to the extent of 44 milligrams per 100 ml. of the medium. The yeasts were grown in tubes bent at an angle of 45° and mounted on a shaking machine specially constructed for the purpose. The tubes were shaken 80-90 times per minute thus securing efficient aeration of the reaction medium and the cultures were allowed to grow for 24 hours. At intervals, growth of this yeast in the medium was measured by centrifuging at constant speed and for known time (10 minutes), a 2 ml. aliquot of the medium in specially made centrifuge tube provided with a calibrated capillary. The results of the rate of growth are graphically represented in Fig. 1.

A careful study of the graphs reveal that the growth-promoting efficiency of a given quantity of nitrogen as measured by the rate of growth, is the highest in the case of the "Difco" yeast extract. Next in the decreasing order, follow distillery yeast extratt, bran extract, extract of groundnut cake, ammonium sulphate, asparagine and lastly, urea. The extent of the growth of yeast at the end of 16 hours with distillery yeast extract as the source of nitrogen, tends to be higher than what is apparently obtainable with "Difco" yeast extract when the overall growth at the end of the experiment is taken into consideration. During the first ten hours, the rate of yeast growth with bran extract appears to be in no way inferior to that given by the two yeast extracts; the groundnut cake extract, however, has a definitely low efficiency. The rate of growth with extracts of bran and groundnut cake is sharply arrested at the end of ten and sixteen hours respectively, indicating a practical depletion of the more easily assimilable forms of nitrogen. In striking contrast to this phenomena is the behaviour of ammonium sulphate and asparagine, both of which tend to maintain a comparatively low but a steady rate of growth.

PART II. DETERMINATION OF THE "QUALITY" OF THE YEAST CROPS HARVESTED ON DIFFERENT SOURCES OF NITROGEN

The organism was grown in Roux flasks containing 100 ml. of the respective media; they were placed in a flat, in a horizontal position, with a view to secure a shallow depth and a large surface for the culture solution. This facilitated aeration of the cultures essential for yeast growth. After 24 hours' growth at room temperature (27°-

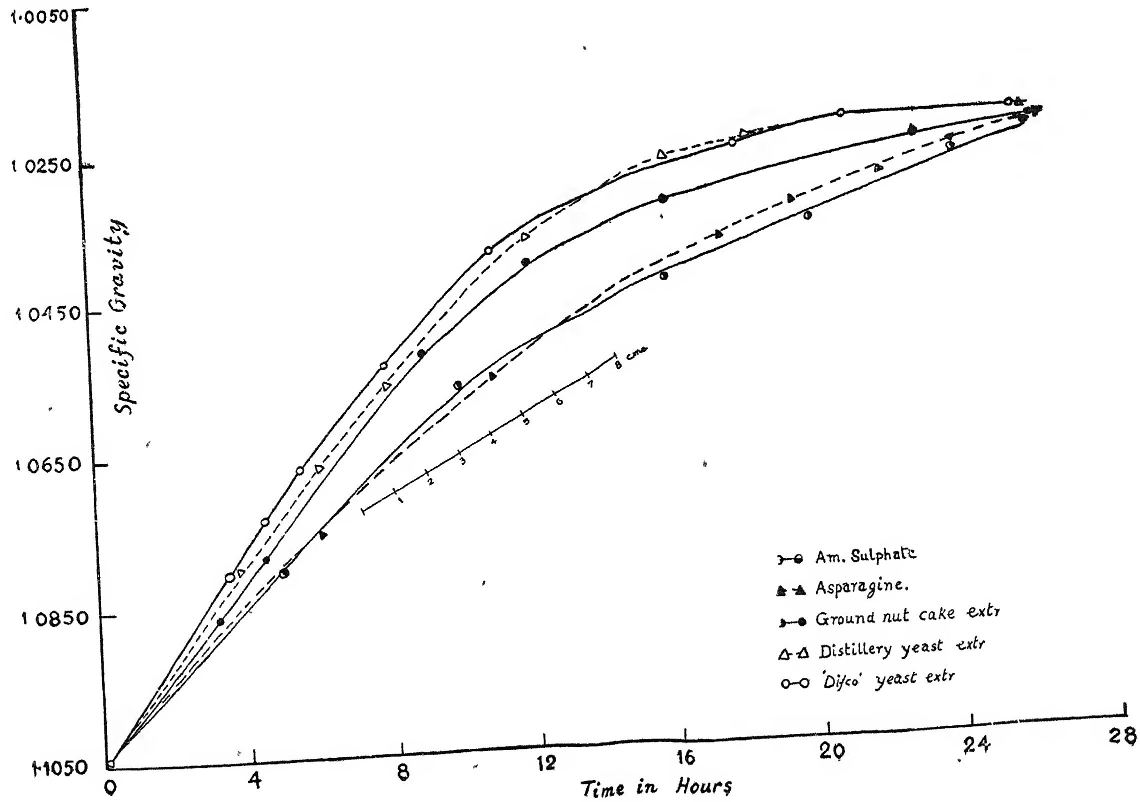

FIG. 2

28° C.) the cultures were collected and washed on the centrifuge. The yeast crop was taken up in saline, made into a thick and uniform suspension, preserved in the ice-chest and its yeast content (on the moisture-free basis) per ml. of the suspension determined by evaporating a known volume of the suspension in a platinum dish, and weighing it to constant weight. The suspension served as the inoculum; a volume of suspension equivalent to 0·4 gm. of moisture-free yeast was employed for every 30 ml. of the experimental mixture for determining the attenuating power of the yeast. The sucrose concentration of the mixture at the start was maintained at 20 per cent. Periodic determinations of attenuation were carried out by noting the specific gravity of the fermenting liquid with the aid of Westphal's specific gravity balance. The results are graphically represented in Fig. 2.

From the graphs given in Fig. 2, it will be seen that the attenuating efficiency of the yeast crops harvested on both the yeast extracts as the source of nitrogen, run very nearly parallel, that of the yeast grown with the groundnut cake extract is definitely low. The yeast crops grown on asparagine and ammonium sulphate process comparatively poor attenuating efficiencies.

In accounting for the higher "quality" of the crops grown on yeast extracts, we have to take into account the vitamins associated with the extracts. Although the strain of the distillery yeast employed in these studies have been demonstrated to be largely independent of external supplies of vitamins, their rates of synthesis by the organism do not appear to be sufficiently high to shorten the period of production of the "pitch". Through a supplementation or fortification of the nutrient media with extracts from natural sources, better harvests of yeasts with higher attenuating powers can be obtained. In this respect, yeast extracts offer the best source of supplements. These findings should find immediate practical application; steps are being taken to apply these results in large-scale distillery practice.

In conclusion we wish to tender our grateful thanks to Sir J. C. Ghosh, our Director, for the keen interest he has taken in the course of these investigations.

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PRESERVATION OF PRAWNS AND ITS EFFECTS ON THE NUTRITIVE VALUE*

BY S. T. CHARI, B.SC., AND P. ANANTHA PAI, B.SC.
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1. INTRODUCTION

PRAWN FISHERY has gained an important position in the economics of the West Coast fisheries of this Presidency. The importance becomes all the more redundant when it is found that the fishery is carried on a large scale during the monsoonic months of May to August when the scope for the other fisheries is limited. The biological aspects of this fishery and the bearing of the ecology of the sea on the fishery are under study in the Biological Station at West Hill. The researches carried out in the Marine Biological Station show that the rainfall has a bearing on the fishery. A heavy monsoon is usually followed by a good prawn fishery. The great influence that prawn fishery holds on the economic balance of the West Coast fishery may be judged better by the following data of the prawns landed on the West Coast for the last three years:—

1943-44	1,55,665	maunds.
1944-45	2,72,805	„
1945-46	1,56,025	„

The remark of Sir Frederick Nicholson "that prawns worth Rs. 15,000 at low price were caught in a single day at Tanur in July", is significant. The peculiarity of this fishery as is seen in the case of the shrimp fishery of Carolina, Florida and Georgia coasts of America is that the fishery is abundant only for a short while at a time interspersed with irregularly longer or shorter periods of slackness. This eventually leads us to the question of treatment of prawns during these periods of glut.

2. PRIMITIVE METHOD OF TREATMENT OF PRAWNS

The most usual or primitive form of treatment of prawns during seasons of glut is to dry them on the beach. Prawns from the boat are carried on to the sea shore and spread over the sand without being washed or cleaned. They are allowed to be dried by mere solar heat. The complete drying takes a period of two to three days provided the weather is normal. If the weather is inclement, the process fails resulting in an enormous waste. Thus much valuable food is strewn along the sands of the beach leaving it to the vagaries of merciful nature which, if favourable, provides it to be marked as "Edible" or otherwise to be used as "Manure".

The analysis of beach-dried prawns as can be seen from Table II below gives a high percentage of sand and shows that the nutritive value is lowered and at the same time provides the consumers with a hard commodity not too palatable. Attempts were made in this laboratory to produce a highly hygienic product in

* Published by the kind permission of Director of Industries and Commerce, Madras.

which the nutritive value will be least affected and applicable to field production. In this communication, we are giving the methods of semi-drying in the laboratory, its scientific interpretation and its application to the field almost under identical conditions.

3. Principle of Semi-Drying

The principle of semi-drying is one of dehydration combined with the preservative action of common salt. A quantity of moisture (10 per cent.) is removed by boiling and the rest by the salt, combined with solar heat.

4. Laboratory Process of Semi-Drying

The prawns, *Peneus monodon*, was taken for the study as this formed the bulk in the landings of prawns. The prawns were washed well in fresh water and put in 5 per cent. boiling brine (common salt) contained in a tinned copper vessel. They were allowed to remain in this solution of boiling brine until they assumed a pinkish colour and floated on to the surface. This floating to the surface and the appearance of pinkish colour are the criterion for their removal from the solution. This phenomena happen in a short period of four to six minutes. They were then laddled out and spread on glass plates for cooling and then shelled. The shelling was done by hand. The shelled flesh was then kept immersed in saturated brine (25 Be.) for fifteen minutes, to allow the ready penetration of salt. It was then dried in an air-oven at 50° C. for four hours. The final dried product had the appearance of fine pink coloured lozenges.

5. Application to Field Work

The experiment was repeated on a technological scale except that the drying was done on raised bamboo barbacues, with solar heat (90° F.). The period of six hours (10 a.m. to 4 p.m.) was found necessary to dry the product to the required consistency on a sunny day. No notable variation was observed, from the laboratory procedure in its application to the field.

6. Methods of Analysis

The method of analysis followed was the same as described by the Association of Official Agricultural Chemists, Fifth Edition, Washington, 1940. The minced sample was analysed for its moisture content as usual by drying in an air-oven at 100° C., nitrogen by the Kjeldahl method from which the protein was arrived at by employing the usual factor 6·25, ash by heating the sample to dull-red heat after initially driving out all carbonaceous matter, fat by extraction in a thimble in a Soxhlet's apparatus with ethyl ether for about 12 hours, the carbohydrate by difference, phosphorus by the ammonium molybdate volumetric method, calcium by the McCrudden's permanganate method, and iron by the Elvehjem-Kennedy method, colorimetrically by using a Helige-Duboscq colorimeter.

The following table gives the values of analysis of fresh and semi-dried prawns:—

Table I

Particulars	Water	Percentage composition on moisture-free basis								
		Proteins	Ash	Fat	Carbohydrates	P.	Ca	Fe	Insolubles	NaCl.
	%	%	%	%	%	%	%	Mgm%	%	%
1. Fresh prawns (*Peneus monodon*)	78·46	81·91	7·15	1·90	9·04	1·59	1·01	21·36	—	—
2. Semi-dried prawns (*Peneus monodon*)	40·60	62·59	24·33	1·65	11·43	1·05	1·05	17·82	0·40	17·18
3. Beach-dried Prawns (*Peneus monodon*)	22·65	59·91	30·17	0·93	8·99	1·66	0·54	8·68	19·86	

Table II

No.	Raw weight of prawns	Weight after boiling	Quantity of 25 Be brine used	Conn. of this brine after treatment	Shelled weight	Final weight
1·	85 Lbs	75·5 Lbs	25 Lbs.	18 Be.	28·25 Lbs	14·10 Lbs
2·	125 ,,	109 ,,	40 ,,	18·5 ,,	40·5 ,,	21·75 ,,
3·	100 ,,	89 ,,	30 ,,	17 ,,	34 ,,	16 ,,
4·	200 ,,	175 ,,	70 ,,	19·5 ,,	66 ,,	28 ,,
5·	125 ,,	107 ,,	40 ,,	18·5 ,,	40 ,,	21 ,,

The above table gives how the product is altered by the different processes involved in the method.

7. Discussion

It is seen that the moisture content in the processed stuff is as high as 40·6 per cent., yet the preservation is effected by the salt which is present in high concentration as can be judged from the ash content which analysed 17·18 NaCl. The low protein content and high salt content are accounted for by the penetra-

tion of salt (even in a short interval) into the tissue cells by osmosis, extracting out the water as well as some water and salt soluble nutritive elements along with it. Yet the loss in the nutritive elements is not appreciable The low weight (about one-sixth) of the final product is partly owing to the removal of the shells which accounted for 50 per cent. of the loss and partly by the dehydration of salt and sun's heat. Field experimental product also yielded identical results. The only dissenting factor is the slightly high amount of labour involved in the shelling by hand. Studies in the shelling by "dancing of the prawns" as practised in Florida, are under way.

The product is found to retain its prawn flavour and with slight soaking is an excellent and nutritive article of diet. If packed in deal-wood boxes lined with butter-paper and stored in a cool dry place, it is found to remain good for at least two months.

8. Resume

(1) A method of preservation of prawns (*Peneus monodon*) by semi-drying is enunciated. Semi-drying retains the nutritive elements and keeps the product supple at the same time preserving it for a fairly good period.

(2) The laboratory details are applied to field-work.

(3) Analysis of prawns. fresh, beach-dried, and semi-dried, are gvien.

Our thanks are due to Sri M. Devidas Menon, B.Sc, (Hons.), of the Marine Biological Station, West Hill, for identifying the species and evincing a keen interest in the paper.

1. Association of Official Agricultural Chemists, *Methods of Analysis*, 1940, 5th Edition, Washington. D. C. 2. Fitting A. W., *Canning Shrimp—Mem. S.* 10 *Dept. of Commerce, Bureau of Fisheries*, Washington. 3. *Bulletins of the Madras Fisheries Department.* 4. Chacko, P I., "Prawn Curing in Madras" *Ind. Farming*, June, 1944, 5, 6. 5. Chidambaram, K., and Venkataraman, R. S., "Prawn and Crab Fishery in Madras," *Ind. Farm.*, October, 1944 5, 10. 6. Chopra B., "Prawn Fishery of India—Presidential Address of the Indian Science Congress," 1943. 7. Chidambaram, K., and Devidas Menon, "Correlation of West Coast Fisheries with Plankton and certain Oceanographical Factors," *Proceedings of the Indian Academy of Sciences*, 1945, 22. 8. "Description of the Shrimp drying industry of the Bantaria region," *Mem. S.* 9—*Bureau of Fisheries*, Washington. 9. John, C. C., *Prawn Industry of Travancore*. 10. Lund, F. P., "Canning Crab and Shrimp Meat," *Mem S.* 96. *Bureau of Fisheries*, Washington. 11. Devidas Menon, M., "Prawn Culture in Paddy fields in Cochin State—A report to the Marine Fisheries Development Board, Madras" (Unpublished). 12. Scofield, W. B., 'Shrimp Fisheries of Carolina," *Mem. S.* 177 *Dept. of Commerce Bureau of Fisheries* Washington. 13. "Shrimp Industry of South Atlantic and Gulf States," *Mem. S.* 9. *Dept. of Commerce, Bureau of Fisheries* Washington. 14. "Statistical Statements of the Fisheries Branch of the Dept. of Industries and Commerce, Madras," years 1943–46.

THE ICAROSCOPE

THE icaroscope is a new optical device for observing objects in the sky near and in front of the sun, developed as a result of wartime research. It was described at the October meeting of the Optical Society of America in New York by Dr. Brian O'Brien, of the Institute of Optics, University of Rochester. The principle of phosphorescence is employed, using special kinds of phosphors with strong afterglow properties which are not much greater, however, for exposure to the sun itself than for exposure to the sky around the sun. This achieves a reduction in the intensity of the solar image sufficient to permit observation of the sun and surrounding sky simultaneously.

The afterglow image does not persist very long, nor is it desirable that it do so if scanning of the sun and sky is to take place. The icaroscope is fitted with a rotating shutter which regularly interrupts the sunlight striking the screen which is coated with the phosphor. Each time the phosphor is exposed, it is energised to emit the afterglow image. Another similarly rotating disk shields the screen from the observer while the sun is shining on it, but allows him to observe the screen between exposures, when the afterglow image is visible. The contrast between the sun and its surroundings is reduced to a small fraction of its original value. At a rate of 90 exposures a second, persistence of vision obscures the fact that the image is not continuous.

The entire icaroscope, including optical parts for viewing the image, is small enough to be carried almost as easily as a pair of binoculars.

A use for the icaroscope which was probably not foreseen during its development was the observation of the initial flash of the above-water explosion of the atomic bomb at Bikini this summer. It made possible direct visual observation of that extremely intense light source.

—(*Courtesy of "Sky and Telescope,"* No. 61, November 1946, p. 11.)

LETTERS TO THE EDITOR

A RELATION BETWEEN THE COMPRESSIBILITY AND THE MELTING POINT OF THE ALKALI HALIDES

In a note[1] published in *Current Science*, the present author showed that a simple relation exists between the melting points, T_m, of the metals crystallising in the cubic system, their shear constants $(C_{44})_0$, and their interatomic distances r_0, the last two being measured at the absolute zero of temperature. It was found that in each case

$$\frac{(C_{44})_0\, r_0^3}{kT_m} \approx 64 \qquad (1)$$

where k is the Boltzmann constant. Curiously enough, this relation is not obeyed by the other class of solids having the simplest structure, namely, the alkali halides. It is, however, found that they obey an analogous relation[2] between the compressibility at the absolute zero $(\chi)_0$ and the melting point, which in its turn is not obeyed by the metals.

$$\frac{r_0^3}{\chi_0\, kT_m} \backsimeq \text{constant.} \qquad (2)$$

This is shown in the table where, the room temperature data, of both the compressibility and the interatomic distance, have been used, in order to avoid the difficulty of extrapolation to the absolute zero. Data have been taken from Huggins[2] where references have been given.

Table

Salt	$\frac{r_0^3}{\chi_0\, kT_m}$
LiF	43·4*
LiCl	41·0
LiBr	42·7
LiI	45·7
NaF	33·6
NaCl	35·3
NaBr	36·9
NaI	37·6
KF	36·3
KCl	38·2
KBr	38·7
KI	36·0
RbF	38·4
RbCl	38·3
RbBr	38·3
RbI	40·9

* Slater's[3] value of compressibility gives the ratio as 33·6.

The relation (2) can be easily obtained by equating the Einstein and the Lindemann formulæ (3) and (4) respectively for the Debye characteristic frequencies.

$$\nu = \frac{\text{constant}}{\chi^{1/2} \cdot A^{1/3} \cdot \rho^{1/6}} \qquad (3)\ \text{Einstein.}$$

$$\nu = \text{constant} \times \sqrt{\frac{T_m}{A \cdot V^{2/3}}} \qquad (4)\ \text{Lindemann.}$$

A in the formulæ stands for the atomic or the molecular weight, ρ for the density, and V for

the atomic or the molecular volume. The fact that (2) is not obeyed by the metals, suggests that in their cases a modified Einstein formula with $\frac{1}{(C_{44})_0}$ in place of χ_0 should give a better value of the characteristic frequency. Actual calculations seem to support this conclusion.

Both the relations (1) and (2) can, however, be derived in a rough way on the basis of the Lindemann theory of melting. According to this view, the average amplitude of vibration at the melting point bears a constant ratio to the interatomic distance. The reason, for the difference in the formulæ for the metals and the alkali halides, is then seen to lie in the fact that in the former case, the force constant between the nearest atoms is approximately obtainable from $(C_{44})_0$, and in the other from the reciprocal of the compressibility.

Dept. of Physics, BISHESHWAR DAYAL.
Benares Hindu University,
November 17, 1946.

1. Dayal, *Curr. Sci.* 1945, **14**, 261. 2. Huggins, *J. Chem. Phy.* 1937, **5**, 143. 3. Slater, *Phys. Rev.*, 1924, **23**, 488.

BLAINI–TALCHIR

DURING recent investigations of dam sites on the Kosi river in Eastern Nepal certain exposures have been found which help to elucidate the age and nature of the Blaini boulder bed in the Western Himalaya. The vicissitudes of opinion about this rock formation may be judged by reference to the literature ending with letters by K. P. Rode and myself to *Current Science* three years ago.[1] East and west of Barahakshetra (26° 52′ 36″ : 87° 10′ 7″) and extending on both banks of the Kosi river, there is a zone of rocks, some of them Gondwana in age, which is bound to the south by a thrust plane against the Nahan series and which is overlain by the thrust unit of the Dalings. The general sructural disposition is similar to that in the Darjeeling-Teesta foothills with the difference that the Gondwana and associated rocks in the Kosi area occur not only south of the Daling thrust but appear to crop out northwards in the form of a tectonic window, below the Daling series, which probably extends laterally up the Sun Kosi and Tamur rivers. From the point of view of this discussion the relevant rock types, all in close association are (1) Boulder Slate, (2) Carbonaceous Shales, (3) Dolomite.

The boulder slate is seen in numerous exposures, but best of all on the water-smoothed exposure below normal monsoon flood level on the left bank of the Kosi some quarter-mile upstream from Barahakshetra, where it may be about 200 feet thick. Elsewhere it is probably thicker. Both cleaved and uncleaved types are found and both are identical to the Blaini rocks between Solon, Mussoorie and Lansdowne. A freshly fractured surface of the cleaved type of boulder slate frequently discloses nothing more than a dark gritty slate, apparently without inclusions. Weathered surfaces show, however, that there are humerous angular pebbles of dark slate, grey quartzite, vein quartz and pale limestone set in a gritty matrix (Fig. 1). Under the microscope the matrix is seen to be typical of an ungraded tillite.

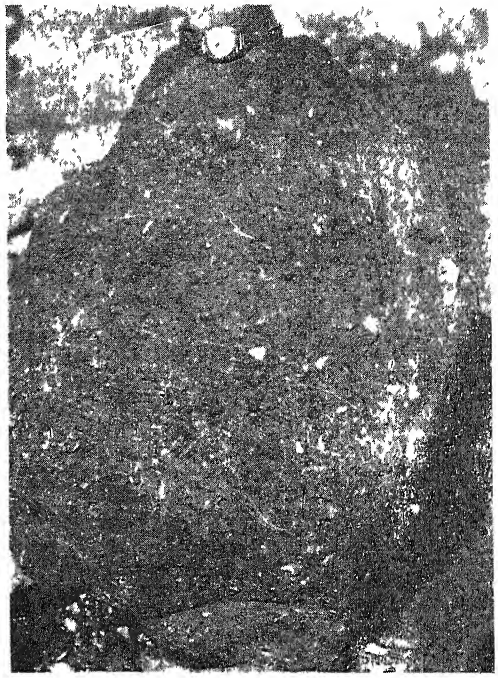


FIG. 1. Boulder of Boulder Slate of Blaini type and probable Talchir age. Kokaha Nala, Nr Barahakshetra, Kosi River, Nepal.

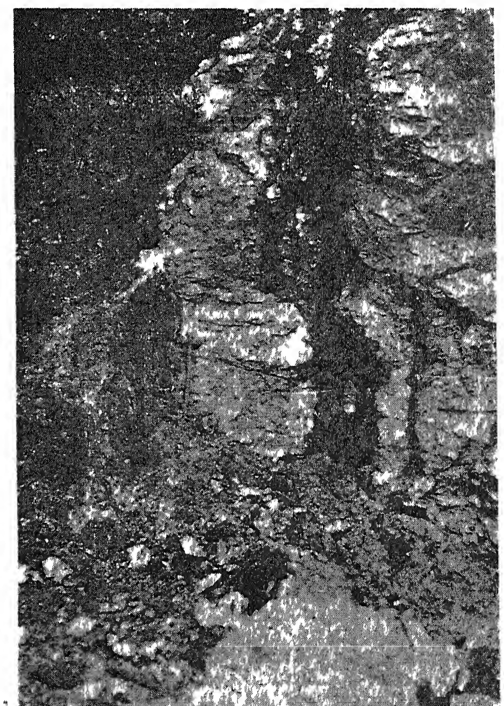


FIG. 2. Impure highly sheared coal adjacent to and embedded within Dolomite, with "horses" of dolomite in coal. Kokaha Nala, Nr. Barahakshetra, Kosi River Nepal.

Several seams of highly sheared black carbonaceous shale have been found, always in proximity to boulder slate, and associated with less carbonaceous shale, grey sandstone and dolomite. The carbonaceous matter is frequently converted to graphite, particularly around rock inclusions. The dolomite forms the southern limit of the series and is thrust upon the Nahan series with a strong tectonic discordance. In two instances carbonaceous shale lies embedded within dolomite, which in places is metasomatised and partially replaced by silica. The carbonaceous shale resembles exactly in hand specimen many of the less pure uneconomic coal seams of the Gondwana series in the Darjeeling foothills, such as near Kalijhora (26° 56′:88° 27′), which are extremely high in ash and quite unburnable. The following analyses of the Kosi Coaly rocks were carried out by Dr. Dutta Roy in the laboratory of the Geological Survey of India :—

	15 ft. Seam Kokaha Nala (mean of 2 analyses)	7 ft. Seam Kokaha Nala (mean of 2 analyses)
Moisture	1·01%	2·17%
Volatile Matter	5·05	4·52
Fixed Carbon	6·10	3·46
Ash	86·36	89·27
Carbon Dioxide	1·48	0·58
Fuel Ratio	1·2	0·77

This is not the occasion to do more than mention the anomalous characters and position of the Kosi carbonaceous rocks. Virtually all the Lower Tertiary and Gondwana coals of the outer Himalaya between Jammu and Darjeeling have undergone strong shearing and possess fuel ratios ranging from 2·5 to 8·0. The average fuel ratio, determined from 150 analyses of Eocene coals from Jammu is 4·7. For five Darjeeling Gondwana coals listed on page 50 of *Mem. Geol. Surv. Ind.*, LIX, the ratio is 4·73. Even the tree stems found so often in the Lower and Middle Siwaliks (late Tertiary) have fuel ratios ranging between 1·30 and 2·0. Yet in the samples collected from the Kosi region the ratio is as low as 0·77–1·2, even after allowance had been made by Dr. Dutta Roy for the calcium and magnesium carbonates present in the ash which dissociate on carbonisation with the liberation of carbon dioxide. It is possible that the Kosi carbonaceous shales represent coal which had been locally eroded on the shore of the Permo-Thias sea and was redeposited, concomitantly with the precipitation of dolmite out of solution, in the marine waters.

In the present context the association of the three rock types enumerated above is of importance in connecting up the Western Himalaya with East Nepal, Darjeeling and the Peninsula. Firstly, the proximity of the Kosi boulder slates, resembling tillite, with carbonaceous graphitic shale, which is very similar to coals of known Gondwana age in the Darjeeling foothills, is a strong indication that the boulder slate is in fact equivalent to the Talchir boulder bed. Secondly, the stratigraphical relationships between the rocks in the Western and Eastern Himalaya may be compared :—

Inferred Age	Western Himalaya	Eastern Himalaya
Permo-Trias	Krol limestones and dolomites	Barahakshettra Dolomite
Permian	Banded carbonaceous slates (Blaini Slates) (banding of Varve type)	Carbonaceous and graphitic slates, sandstones. Coal in Darjeeling
Upper Carboniferous	Blaini boulder beds often cleaved to boulder-slate	Boulder bed locally cleaved to boulder slate (Talchir)
? Devonian	Nagthat Series	Series of white and purple quartzites, purple, green, and dark slates (position at present uncertain, but below the Gondwanas)

While more work is required in the intervening region, 500 miles in length, between the Kosi and Naini Tal, before definite conclusions can be drawn, it seems very probable that the boulder slate of the Kosi region and the Blaini boulder bed of the Western Himalaya are equivalent, that the age of the Blaini is in fact Talchir or Upper Carboniferous, and that it is glacial in origin. On grounds of structure as mapped in the Solon-Mussoorie-Lansdowne area, I had previously disputed K. P. Rode's contention that the Blaini boulder bed is a Tertiary tectonic breccia devoid of stratigraphical significance. The opinion of the Geological Survey of India is now seen to be strengthened by the disposition of the Kosi rocks.

It may be remarked that in 1933 L. R. Wager found a boulder bed on Lachi hill, in north-east Sikkim.[2] I saw his specimens when in England that year and visited Lachi in 1934.[3] This boulder bed very closely resembles the uncleaved Talchir boulder beds of the Peninsula. The recent topographic survey of Sikkim establishes that the geographical co-ordinates of Lachi hill are 28° 1′ 12″:88° 44′ 15″ and its altitude about 18,500 feet.

It is evident that the Gondwana ice sheet spread well into the area which is now included within the Himalaya and that in the Kosi region there was a somewhat longer duration of continental conditions than obtained further north-west. But whereas the Talchir glaciation and impure coal (Kosi), and the banded Varved carbonaceous slates (Solon-Naini Tal), were followed in those areas by non-fossiliferous marine rocks, in Northern Sikkim and the Salt Range the marine conditions were favourable to the existence of life,

The top beds of Lachi series of L. R. Wager contain marine Permian fossils. These are succeeded by the Tso Lhamo series, containing a well-developed Muschelkalk fauna, which I located in 1934.[4] In the Salt Range the boulder bed is followed by fossiliferous marine Permian and Trias rocks. Somewhere between the Kosi-Krol zone and the North-Sikkim/Salt Range zone there must have been an ecological boundary separating marine waters. South of this boundary conditions inhibited the existence of life, whereas north of it there was an abundant fauna. As to how far the north edge of the Gondwana continent and the subsequent ecological barrier have been telescoped and displaced by the later Himalayan movements cannot at present be indicated.

Engineering Geology Section,
Geological Survey of India,
Calcutta,
November 11, 1946.

J. B. AUDEN.

1. *Rec. Geol Surv. Ind.*, 1908, **37**, 129 *Mem. Geol. Surv. Ind.* 1928, **53**, 132. *Rec Geol Surv Ind*, 1934, **67**, 365 *Op. cit.*, 1937, **71**, 414 *Proc. Ind. Acad. Sci.*, 1943, **17**, 157. *Curr. Sci.*, 1943 **12**, 299. *Op. cit*, 1944, **13**, 74. 2. "*Everest* 1933," 1934, p. 333. 3. *Rec. Geol. Surv. Ind.*, 1935, **69**, 151. 4. *Ibid.*, p. 152. *Op. cit.*, 1939, **74**, 172.

ALPHA-NAPHTHOL AS AN INDICATOR

THE use of diphenylamine as an internal indicator in the titration of ferrous ions by potassium dichromate is well known.

Since alpha-naphthol and beta-naphthol on oxidation are reported to undergo a transformation into dinaphthols[1] which have respectively violet and greenish colorations, it was thought desirable to study the use of these reagents as internal indicators in the above titration.

To 10 c.c. of the ferrous salt sol., 10 c.c. of the phosphoric-sulphuric acid mixture was added, followed by 20 c.c. of dil. sulphuric acid. Finally 5 drops of the alpha-naphthol reagent (1% solution in con. sulphuric acid) were added and the mixture titrated against decinormal dichromate. As the titration proceeded, a green colour developed and when the reaction was complete the colour was at once discharged. This change is sufficiently well marked to signify the end-point. For the sake of comparison, titrations were carried out with diphenylamine as an internal indicator. An average of three titrations gave the following readings: (*a*) with diphenylamine as indicator, 10·05 c.c. dichromate; (*b*) with alpha-naphthol as indicator, 10 c.c. dichromate.

It may be pointed out that, with diphenylamine as internal indicator, the dichromate reading is usually 0·05 c.c. higher than with potassium ferricyanide as external indicator.

This indicator has certain drawbacks. It fails to work in back-titration, as well as with dilute reactants. If a ferric salt solution is reduced by stannous chloride, this indicator fails to work in subsequent titration with dichromate. The disappearance of a colour is never so much advantageous as appearance of a colour. Yet the use of alpha-naphthol as an internal indicator in this titration is worth introducing. Beta-naphthol gave no satisfactory change of colour.

Public Health Laboratory,
Kolhapur State,
Kolhapur,
October 9, 1946.

J. W. AIRAN.
G. N. PANDIT.

1 Bernthsen, *Organic Chemistry*, Tr., Sudborough, 1944, Edition, p. 574.

INDUCED OXIDATION OF TARTARIC ACID BY POTASSIUM DICHROMATE WITH FERROUS SULPHATE AS INDUCTOR

TARTARIC ACID is slowly oxidised by chromic acid or potassium dichromate to meso-oxalic acid. In acid medium it is completely oxidised to carbon dioxide and water. The different oxidation stages of tartaric acid are as under:

$$\begin{array}{l} COOH \\ | \\ CHOH \\ | \\ CHOH \\ | \\ COOH \end{array} \xrightarrow{2O} \begin{array}{l} COOH \\ | \\ CHOH \\ | \\ COOH \end{array} \xrightarrow{O} \begin{array}{l} COOH \\ | \\ CO \\ | \\ COOH \end{array} \xrightarrow{2O} 2CO_2 + H_2O$$

The reaction is extremely slow but addition of ferrous sulphate to an acidified solution of tartaric acid induces the oxidation and then the oxidation takes place as fast as the solution of chromic acid or potassium dichromate is added until the tatronic acid stage is reached. The mixture gives test for ferrous ion. Further reaction takes place with a slightly diminished speed and in this later stage the mixture shows the presence of ferrous ion only on standing for some time indicating that the ferric ions first formed oxidise the organic acid molecules and are themselves reduced to the ferrous condition. Further reaction beyond the meso-oxalic acid stage is apparently not induced by ferrous sulphate.

Similar investigation on oxalic acid reveals that unlike in the above case, (*i*) the reaction between oxalic acid and potassium dichromate is not induced by ferrous sulphate, (*ii*) but that potassium dichromate rapidly oxidises ferrous sulphate and simultaneously oxalic acid with a slow rate.[1]

Experiments were also made using potassium permanganate as an oxidising agent. It is interesting to note that ferrous sulphate does not induce the slow reaction between tartaric acid and potassium permanganate. An experiment with oxalic acid brought out a noteworthy fact that a mixture of ferrous sulphate and oxalic acid can be completely oxidised by titrating with potassium permanganate *in cold*. No heating is necessary as is usually recommended for the titration between potassium permanganate and oxalic acid. Apparently, however, this is not a case of induction by ferrous sulphate as even without addition of ferrous sulphate the reaction between potassium permanganate and oxalic acid takes place quickly.

In all the above experiments decinormal solutions of the various reagents were used.

Luther and Rutter[2] explained the induced reduction of chromic acid in presence of some metallic salts as inductors on the basis of pro-

duction of quinquevalent chromium ion which is relatively more reactive. Similar explanation was put forward by Wagner and Preiss[3] for the induction of the reaction between chromic acid and iodide by ferrous salts. We believe that it is not the quinquevalent chromium ion but the chromium chromates which may be formed at intermediate stages in the reduction of chromic acid or chromates that are responsible for the induction process. In this connection it may be stated that it has been observed in this laboratory that at the intermediate stages during the reduction of chromic acid and chromates by tartaric acid the formation of chromium chromates is indicated. The reduction of chromic acid or chromates by oxalic acid on the other hand is not stagewise and is not accompanied by the formation of the chromium chromates.[4] This explanation can account for most of the above experimental observations.

Further work is in progress.

Our thanks are due to Prof. D. B. Limaye for kind encouragement.

Department of Chemistry, D. A. V. College, Sholapur, November 15, 1946.

D. S. Datar.
S. N. Kelkar.

1. *Cf.* Viswanadhan and Rao, *Curr. Sci.*, 1943, **12**, 327. 2. Luther and Rutter *Z. Anorg Chem.*, 1907, **54**, 1 3. Wagner and Preiss, *Ibid.* 1928, **168**, 265 4. Datar and Kelkar, *J. University Bombay*, under publication.

A COMPARATIVE STUDY OF ACID AND ENZYMIC EXTRACTIONS OF NICOTINIC ACID FROM FOODSTUFFS

The usual procedure followed for the extraction of nicotinic acid from foodstuffs, is by the use of either acid or alkali. This procedure is so drastic that often highly coloured extracts—especially from plant materials—are obtained, which necessitate separate blank estimations in every case. Further, improper evaluation of the blank values has been shown by Melnick and Field (1941) to yield erroneous values. Extraction of nicotinic acid has also been achieved by the use of enzymes, *viz.*, taka diastase and papain (Chedelin and Williams, 1942) and by an enzyme preparation from the pig's intestinal mucosa (Bhagvat, 1943). Enzymic extraction of nicotinic acid from foodstuffs yields colourless or very slightly coloured extracts, thereby eliminating the blanks. The object of the present investigation was to compare the nicotinic acid values of foodstuffs on their extractions with 2N HCl and with an enzyme preparation from pig's intestinal mucosa.

The enzymic extracts of foodstuffs were prepared and tested as described by Bhagvat (*loc. cit.*).

The acid extracts, were prepared by extraction of 1-10 gm. of the foodstuffs with 50 ml. of 2 N HCl for 15-20 minutes in the water-bath. The extracts were filtered, neutralised and treated with basic lead acetate in order to remove interfering substances. The excess of lead was removed by H_2SO_4 and the nicotinic acid in these extracts was estimated by the cyanogen-bromide method. Since the acid extracts were coloured blank estimations to evaluate the residual colour were done. In every case, two blank estimations—(1) dilution blank—a known aliquot of the extract—was diluted with water to a definite volume and the colour compared directly in the colorimeter; and (2) aniline blank (same as dilution blank, but instead of water, aniline was used), were carried out. The results are given in the table.

Nicotinic Acid Content of Foodstuffs

Materials	μg nicotinic acid per gram			
	Acid extraction			Enzymic extraction
	Uncorrected	Corrected using dilution blank	Corrected using aniline blank	
Green gram	41.5	14.8	10·0	16·0
Green gram (sprouted)	7.9	0 75	−1·7	9·5
Horse gram I	18.9	13 6	9·5	15·9
,, ,, II	22.25	10.1	8·9	17·9
Cow pea	8.1	—	—	15·0
Cow pea (sprouted)	12.7	5.4	6·2	14·7
Black gram	24.15	7.5	−0·4	15·1
Wheat	44.5	29.1	26·9	15·7
Wheat bran	90	—	—	74·0
Barley	34.7	26.9	26·9	14·3
Groundnut (ether extracted)	179.5	140.0	139·5	69·0
Mustard	60 6	35.6	34·5	26·1
Sesame	42 9	35.4	34·6	22·8
Dried yeast— Torula	213.0	—	—	215·6
,, Brewer's	465	—	—	472·0
Sheep Liver	107	—	—	107

The nicotinic acid values of foodstuffs (with the exceptions of yeast and liver) vary appreciably with the method of extraction employed. Generally a lower value for nicotinic acid was obtained for pulses by acid extraction than by enzymic extraction. Further a discrepancy was noted between the two series depending upon which blank value was used in the calculations. Acid extraction of cereals and oil-seeds, however, yielded higher values for nicotinic acid than those obtained by the enzymic method. Whether these higher values are due to the presence in cereals and oil-seeds of a precursor of nicotinic acid or a non-specific chromogen, is a matter for future investigation.

The enzyme preparation used in this investigation contains a large and varied array of enzymes which will liberate and extract nicotinic acid from its biological combinations. Taking into consideration the specificity of enzyme action and the presence of a similar type of enzymes in the human body, it might not be too premature to suggest that the values of nicotinic acid obtained by the enzymic extraction represent those which are biologically

availa'le. Further experiments, however, are necessary to prove this point.

KAMALA BHAGVAT.
U. C. MISRA.

Nutrition Research Labs., I.R.F.A.,
Coonoor,
November 11, 1946.

* Parlakimedi Research Scholar.

1. Bhagvat, K. *Ind Jour. Med. Res.*, 1943, **31**, 2, 145. 2. Chedelin, V. H., and Williams, R. R *Ind Eng. Chem. Anal Ed.*, 1942, **14**, 671. 3. Melnick, D., and Field, H., *Ibid*, 1941, **13**, 881.

INFLUENCE OF YEASTS ON PROTOZOAL ACTIVITY IN SEWAGE

IN the course of our studies on the fundamental role of protozoa in sewage purification,[1-3] some interesting observations have been made in regard to the influence of yeasts, when introduced along with the protozoa in different combinations into sterilised sewage, on the purification process.

We have carried out a number of experiments by inoculating cultures of *Saccharomyces cerevisiæ* (one of the most commonly occurring species in certain trade effluents and sewage) together with *Epistylis* sp. (the indicator organism for well conditioned sludge) into sterilised sewage and bubbling air through the suspensions. One set of these experiments is briefly described below.

Samples of actively fermenting yeasts were treated as follows before they were inoculated along with the protozoa into sewage:—(*i*) the yeast inoculum consisted of both the yeast cells and the fermented liquor, in the form of mixed suspension (100 c.c.); (*ii*) the inoculum was only the yeast cells (about 2·5 g. in the wet condition, contained in 100 c.c. of the mixed suspension) filtered and carefully washed with ammonia-free distilled water in order to make the cells free of acid; (*iii*) 100 c.c. of the fermented liquor without the yeast cells (the filtrate from the previous preparation) was employed; (*iv*) the washed cells (acid-free, about 2·5 g. in the wet state) were autoclaved at 15 lbs. pressure for 30 minutes, and the cooked material as such was used; and (*v*) the water extract of the autoclaved material (100 c.c.) was the inoculum. For each of these yeast preparations two litres of heat-sterilised sewage was employed, so that the added yeast suspensions formed about 5 per cent. by volume of the sewage; such a proportion of domestic sewage to trade effluent (as represented by yeast additions) obtains at certain industrial centres. The protozoan inoculum for these experiments consisted of 20 c.c. of fresh *Epistylis* sp., washed well in ammonia-free distilled water. The progress of purification of the sewage samples in the different cases was determined by examining the sludges and the supernatants at frequent intervals during a period of 96 hours. The results of chemical analyses of the supernatants and microscopic examination of the protozoa during the first 24 hours after the treatments are given in Table I.

TABLE I

Treatments of sewage	One hour after the treatments						After 24 hrs. of aeration		
	Supernatants					Microscopical observations on the protozoa	Supernatants		Condition of the protozoa
	Oxygen absorbed from potassium permanganate in 3 mins.	4 hrs	Free and saline ammonia (N)	Albuminoid nitrogen (N)	pH		Oxygen absorbed from potassium permanganate in 4 hours	pH	
Protozoa alone (*Epistylis* sp.) control series	1·75	4·08	1·40	0·40	7·6	Extremely active	0·96	7·6	Active
Protozoa & yeast cells (*Saccharomyces cerevisiae*) together with the fermented liquor	19·60	46·00	3·12	1·02	6·0	Inactive	50·40	6·1	Dead
Protozoa & washed yeast cells	1·84	4·08	1·25	0·62	7·6	Very active	1·12	7·5	Active
Protozoa & yeast liquor with the cells	17·20	46·00	3·57	1·02	6·0	Inactive	50·40	6·1	Dead
Protozoa & yeast cells washed and autoclaved	1·92	4.24	1·40	0·89	7·5	Very active	1·04	7·4	Active
Protozoa & water extract of the autoclaved yeast material	1·76	4·08	1·56	0·62	7·6	Very active	0·96	7·6	Active

The results of chemical analyses of the supernatants are expressed as parts per 100,000.

The results of analyses of samples of the supernatants taken during the subsequent periods of observation consistently showed that the purification of sewage was adversely affected in presence of the actively fermenting yeasts and was traceable to the products of yeast fermentation (the acids, alcohols and related products) rather than to the yeast cells themselves. Addition of lime to the yeast liquor (neutralising the acidity) was found efficacious in the prevention of these adverse effects.

The sensitiveness of the protozoa to reaction and other conditions is, therefore, of great technical importance and emphasises the need for trade effluents to be discharged into the sewers in equable flows so that the whole sewage is not affected.

The above observations would explain the cause of a somewhat mysterious breakdown in one of the earlier Activated Sludge installations in England where flushes of brewery waste were liable to enter the sewer.[9]

Dept. of Biochemistry, Indian Institute of Science, Bangalore,
October 10, 1946.

S. C. Pillai.
M. J. Gurbaxani.
V. Subrahmanyan.

1. Pillai, S. C., *Curr. Sci.*, 1941, **10**, 84. 2. —, *Ibid.*, 1942, **11**, 437. 3. —, *Ind. Med. Gaz.*, 1942, **77**, 118. 4. Pillai, S. C., and Subrahmanyan, V., *Nature*, 1942, **150**, 525. 5. —, *Sci. and Cult.*, 1943, **8**, 376. 6. —, *Nature*, 1944, **154**, 179. 7. — *Sci. and Cult.*, 1945, **11**, 75. 8. —, *Ibid.*, 1946, **11**, 392. 9. Martin, A. J., "The Activated Sludge Process," Macdonald and Evans, 1927, p. 54, and private communication from Dr. G. J. Fowler.

VERNALISATION RESPONSE OF CULTIVATED INDIAN WHEAT

Working with seven strains of Indian wheat, Kar,[1] in a recent article in *Nature*, has put forward the interesting conclusions that (*a*) certain varieties of cultivated Indian wheat differ in their response to the vernalisation process from their closely allied relatives of the temperate region and (*b*) to induce significant earliness from prechilled seeds of cultivated Indian wheat, it is essential that seedlings be subjected to a certain number of long days. Kar writes: "Sen and Chakravarti[2] have reported significant response in certain strains of cultivated wheat in higher altitudes of the Almora Hills, but the light period available to the seedlings at the subsequent photostage was not mentioned."

The daylength to which the seedlings were subjected in "randomised blocks with four replications", in sowings of October 1943 and February 1944, was not specifically mentioned in the note[2] (1945), since from the sowing dates the subsequent photoperiods of this region could easily be inferred. Data of the prevailing daylengths of Almora, however, have been given in an earlier publication[3] (Sen and Chakravarti, 1942), in which the effect of different photoperiods on the vegetative phase of control and vernalised mustard T. 27 was observed in a series of ten successive sowings, beginning from April 1940 to March 1941. As regards the agronomical possibilities of subjecting wheat seedlings to photoperiods other than the prevailing daylength of the region, it has already been pointed out by Sen[4] (1940) that light vernalisation of seedlings has practical possibilities only for a crop like rice or for winter vegetables which are normally transplanted. In small experimental trials, Sen and Chakravarti[5] (1943-44) have found that subjecting seedlings of Soybean C.2 and L.S.S. Cotton to a photoperiod of 9½ hours for only two weeks hastened flowering—six weeks in Soybean C.2 and three weeks in L.S.S. cotton, but the actual labour and cost involved in attempting to shorten the daylength of seedlings in cultivator's fields in India would be prohibitive.

As a result of marked vernalisation response observed in 1943 by Sen and Chakravarti[2] in a few strains of cultivated Indian wheat, a systematic study of the vernalisation response of the available strains has been in progress since 1944, under the climatic conditions of Almora (Lat. 29° 45′ N. Long. 79° 40′ E.) and New Delhi (Lat. 28° 35′ N. Long. 77° 12′ E.). Pure strain seeds obtained from the Imperial Agricultural Research Institute, New Delhi, were vernalised at the Vivekananda Laboratory, Almora, and sown simultaneously with their corresponding controls in similar stage of germination in randomised field plots in Almora and New Delhi. The first sowing of 150 strains was undertaken in February 1944. From the observed vernalisation response of these 150 strains, 63 strains were selected for normal seasonal sowing in October 1944. Investigation with another 150 strains is still in progress, but results so far obtained and reported[6] (1944-45) contradict the generalisations of Kar (1946) about Indian wheat.

The vernalisation responses of the Indian wheat in which an earliness of over ten days in ear emergence has been observed in Almora and in New Delhi in normal seasonal sowings are given in Table I. The prevailing daylength from October 11th begins to diminish from 11·6 hrs. (Almora) and 11·7 hrs. (New Delhi) reaching a minimum of 10·2 hrs. (Almora) and 10·3 hrs. (New Delhi) by the third week of December. After Christmas it begins to increase, reaching the same daylength as of October 11th by March 6th. Since sowings in Almora were on October 14th, and in New Delhi, on October 23rd, all vernalised plants which eared within 143 days in Almora and 134 days in New Delhi had to complete their vegetative phase under short days. It will be seen from Table I that neither in Almora nor in New Delhi were the vernalised seedlings of the various strains of wheat mentioned in the table subjected to any long day, yet the observed earliness in ear emergence was of agricultural significance. This fact clearly shows that prechilled seeds of some of the cultivated Indian wheat will produce plants under short days which give significant vernalisation response. Furthermore, though the plants from vernalised seeds had to complete their vegetative phase under similar short days both in Almora and New Delhi, the vegetative periods of all these strains were longer in

TABLE I

Showing vegetative periods in days of (C) control and (V) vernalised cultivated Indian wheat (I) Almora sowing—October 14, 1944, (II) New Delhi sowing—October 23, 1944. Number of plants is given in brackets.

Strain	(C)	(V)	Earliness (C–V)
(Baluchistan Suraki	(I) 164·7 (30 (II) 140·1 15	135·8 25) 123·5 14	29·0** 16·6**
(Punjab) T·6	(I) 143·8 (28 (II) 125·4 9	129·3 (18 111·3 (20	14·5** 14·1**
(Punjab) T·7	(I) 154·2 (32 (II) 125·4 (17	132·8 21) 110·7 9	11·4* 14·7**
(Punjab) T·20	(I) 145·5 34 (II) 125·3 20	127·7 34) 112·7 22)	17·8** 12·6**
(Punjab) T·21	(I) 149·3 27 (II) 123·2 20)	136·9 18 110·3 21)	12·4* 12·9**
(Punjab) 9 D	(I 134·8 (31) (II 108·3 18)	109·9 33 89·2 15	24·9** 19·1**
(Patiala) Maharaj	(I) 142·3 24 II 118·3 21	122·0 (32 101·7 (27	20·3** 16·6**
(Patiala) (No. 1)	(I 134·8 26 (II) 108·1 (23	118·8 (27 94·1 (20)	16·0** 14·0**
(Sind) A.O. 90	(I) 138·9 25 (II) 118·3 16	128·5 (24 99·7 23	10·4* 18·6**
(Sind) C. S. I. R.	(I) 151·4 34 (II) 126·3 20	131·5 28) 110·1 27	19·9** 16·2**
(Bombay) Bansi 224)	(I) 100·5 32 (II) 95·8 (13)	89·6 (25) 85·6 23	10·9* 10·2**
(Madras) Samba	(I) 141·0 (5 (II) 111·7 16	123·3 (21) 102·1 12)	17·7* 11·5**

*Significant at 5% level; ** Significant at 1% level.

Almora. This difference can partly be attributed to the prevailing higher temperature ranges in New Delhi. Pending the results of another 150 strains of cultivated Indian wheat, we do not feel justified in offering any further generalisation.

Vivekananda Laboratory, Almora,
and
Imperial Agricultural Research Institute, New Delhi,
November 13, 1946.

B. SEN.
S. C. CHAKRAVARTI.
B. P. PAUL.
G. S. MURTY.

1. Kar, B. K., *Nature*, 1946, **157**, 811. 2. Sen, B., and Chakravarti S. C., *Curr. Sci.*, 1945, **14**, 124. 3. —, *Indian J. Agric. Sci.*, 1942, **12**, 1. 4. Sen, B., *Indian Farming*, 1940, **1**, 55. 5. *Progress Report*, *I.C.A.R.* 1943–44. 6. —, 1944–45

ON THE EFFECT OF DIFFERENT CROP ROTATIONS ON THE FIBRE PROPERTIES OF COTTON

IN the black cotton soil tracts of Marhatwada (H.E.H. the Nizam's Dominions), cotton is usually cultivated in rotation with either *kharif* or *rabi jowar* (*Sorghum vulgare* Pers.). In recent years, however, groundnut (*Archis hypogea*) is becoming popular for the purpose since the yields of cotton following this leguminous crop are generally higher than the ones obtainable after either *jowar*. To ascertain this belief a regular rotational experiment consisting of all these three crops in a two and three course systems has been in progress at the Cotton Research Station, Nanded, since 1941-42. It consists of four randomised blocks (individual plot size 1/66 acre) and five rotational treatments detailed below:—

(1) Cotton grown after *kharif jowar*;
(2) Cotton after *rabi jowar* following *mug*;
(3) Cotton after groundnut;
(4) Cotton after groundnut following *kharif jowar*; and
(5) Cotton after groundnut following *rabi jowar* and *mug*.

Gaorani 6 was the variety of cotton used. Further all the crops were grown strictly as per local practice.

During the course of this investigation it was considered desirable to know the effect of these rotational treatments on the fibre properties of cotton since these formed an important basis for determining its value from trade point of view. Accordingly, four-ounce lint samples obtained from each of the plots of the five different rotational treatments were tested for such fibre properties as have a considerable say in determining their spinning value. As such, mean fibre weight per fibre, mean fibre length (mm.) and mean fibre weight per unit length were examined by the usual methods.

The analyses of variance due to these rotation treatments for these different characters were as follows:—

Due to	Degrees of freedom	Variance or Mean Square		
		Mean fibre wt. per unit fibre 10^{-6} gm.	Mean fibre length mm.	Mean fibre wt. per cm. 10^{-6} gm
Blocks	6	·0042	0·312	0·0017
Seasons	1	·0116	0·040	0·0087*
Rotations	4	·0235	0·157	0·0014
Seasons × Rotations	4	·0162	0·237	0·0012
Error ..	24	·0104	0·282	0·0018

* Significant at 5 per cent. level.

The above results clearly indicate that Gaorani 6 has the same fibre properties when grown either after *kharif jowar, rabi jowar* or groundnut and that the different crop rotations are not likely to affect the spinning quality of the following cotton crop.

Similar conclusions regarding the role of previous rotation crops on the fibre properties of the following cotton were arrived at by Gulati[1] (1941) and R. L. N. Iyengar[2] (1943).

The above work formed a part of the programme of work of Indian Central Cotton Committee Schemes at Nanded.

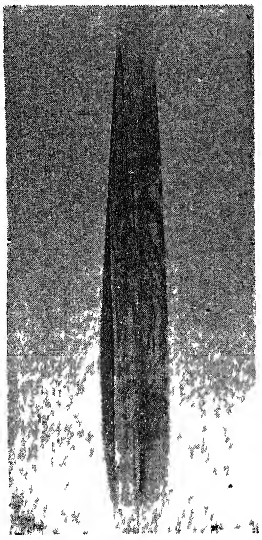
Cotton Research Station, Nanded, Hyderabad (Dn.), P. D. GADKARI. K. G. DEO.
December 3, 1946.

1. Gulati, A. N., "Influence of environment on yield, seed, etc., on P.A 4F and P.A 289 F/43," *Eighth Conf of Tech. Assts.*, Matunga, 1941. 2. Iyengar, R. L. N, "*Fibre Properties of Cotton*," Thesis for D.Sc., of Madras, University, 1943, 137–38.

RHIZOCTONIA-LEAFSPOT, A NEW LEAF DISEASE OF SUGARCANE

A NEW leaf disease of sugarcane was noticed in Gopalpur (Bengal) on Co. 421. The disease has also been seen elsewhere before as is mentioned below. The symptoms observed were as follows:—

Beginning as a small dull red spot in the lamina towards one or the other side of the midrib, the symptom spreads in characteristic concentric zones. The zones are marked by wavy lines of dull red colour alternating with broader whitish areas in between. The spot spreads much faster along the length of the leaf than across it so that the spots are commonly found to be 4°5″-6″ long and 2″-3″ broad. The zones themselves have the thin wavy lines and the whitish zones much broader in the



regions above and below the origin than at the sides. This effect is clearly brought out in the figure.

The symptoms have a slight superficial resemblance to those of the "Banded Sclerotial Disease". Important differences exist, however, between the symptoms produced by the two diseases. While the alternating bands of red and white are common between the two and are suggestive of a close similarity, the dull red colour, and the zones developing in a characteristic concentric fashion from a point of origin on the surface of the lamina easily distinguish the disease described here from the Sclerotial Disease.

The symptoms are to be observed in the beginning of the monsoon season, in the first or second week of July, in both the diseases. But whereas the symptoms disappear in the crop by the end of August or the first week of September in the Sclerotial Disease, the symptoms described above may be seen in November and December in the leaves. The writer, for instance, has observed the symptoms in September-October 1941 in Ranchi, in November 1942 in Purtabpore, on Co. 513, and in October 1943 on Co. 513 and on Co. 313 in Pusa, in Bihar.

The most important distinguishing feature of the disease is, however, the presence of minute dark dots on the surface of the leaves which may be easily observed with the aid of a hand lens (× 10). They represent the dark irregular sclerotia of *Rhizoctonia.* Microscopic examination reveals that the sclerotia are partially embedded in the leaf tissues. The fungus is easily identified as *Rhizoctonia solani* Kuhn.

The disease is always confined to a few canes in a plantation. It does not seem to spread rapidly and is never found generally prevalent in an area or a field.

Dried specimens of the above disease are being deposited with the Herb. Crypt. Ind. Orient, New Delhi.

Directorate of Agriculture, Bengal, S. Y. PADMANABHAN.
October 28, 1946.

FLOWER COLOUR IN *STROBILANTHES DALHOUSIANUS* CLARKE AND *CYNOGLOSSUM MICROGLOCHIN* BENTH.

DURING a recent excursion to Dalhousie-Chamba-Ainpukhri, the writer has noticed a variation in flower colour in *Strobilanthes Dalhousianus* and *Cynoglossum microglochin* which it is thought worthwhile to place on record.

In *Strobilanthes Dalhousianus* Collet[1] reports the flower colour to be dark-blue while Hooker[3] states it to be purple. Along Dalhousie-Ainpukhri Road the species is abundant between 6,000-9,000 ft. Mostly the flowers are dark-blue. At one locality between Khajiar and Dalhousie a clone was observed with pure white flowers.

Cynoglossum microglochin Benth. grows between 7,000-11,000 ft. from Kashmir to Kumaon. According to Collet[1] flowers are dark-blue. Coventry[2] states the flower to be dark-blue or purple in Kashmir specimens. The species is exceedingly abundant at Ainpukhri (Chamba State). Most of the specimens possessed dark-blue flowers but quite a large number of plants were found to possess flowers milky-white in colour.

White-coloured flowers in *Strobilanthes Dalhousianus* or in *Cynoglossum microglochin* have not so far been reported.

Botany Department, Punjab University, Lahore, P. N. MEHRA.
December 2, 1946.

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THE KARYOTYPE OF *CURCULIGO ORCHIOIDES* GAERTN., AND ITS RELATION TO THE KARYOTYPES IN OTHER AMARYLLIDACEAE

SATO (1938) in his masterly review of the various karyotype alterations and phylogeny in the Amaryllidaceæ has analysed (1) 19 genera in the Amaryllidioideæ showing a striking resemblance in their basic chromosome complement and number (b-11) except *Hæmanthus* (b-8) which points to a possible link with that of *Scilla* and of *Alstrœmeria*; (2) 5 genera under Agavoideæ resembling *Yucca*; (3) 2 genera under Hypoxidoideæ-*Alstrœmeria* (2n-16) and Bomalia (2n-18), showing a resemblance to *Hœmanthus* on one side and to *Scilla* on the other.

The present contribution on *Curculigo orchioides* Gærtn., a member included under the sub-family Hypoxidoideæ, is an attempt to compare its karyotype with those of other genera in the subfamily. Root-tips were collected from bulbs grown in the laboratory and fixed in Flemming's medium mixture. La Cour's modification of Newton's iodine-gentian-violet schedule was followed.

The karyotype revealed a diploid chromosome count of 18, as in *Bomalia salsilia*, although in general morphology it falls in line with the karyotypes of the Hypoxidoideæ with a diploid compliment of 16 chromosomes. Fig. 1

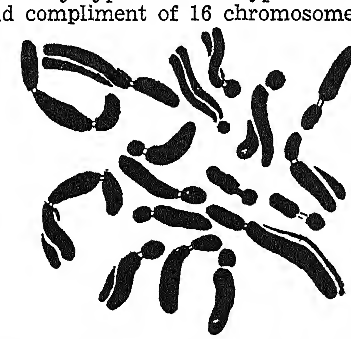

FIG. 1. Somatic metaphase plate × 4050

shows the 18 somatic chromosomes on the metaphase plate. They fall into one pair of long chromosomes with submedian constrictions, one pair of medium-sized chromosomes with secondary constrictions (denoted M^s) and seven pairs of short chromosomes with mostly submedian and subterminal constrictions. No satellites were detected.

Curculigo orchioides =

$$2n = 18 = 2L + 2M^s + 14S.$$

A study of this karyotype strongly suggests a phylogenetic similarity with that of the *Alstrœmeria* type and possibly of *Scilla*. A medium-sized chromosome with a secondary constriction is a feature common to both *Curculigo orchioides* and *Alstrœmeria pulchella*. Sato derives this chromosome of the latter by inversion of a short arm with a satellite of a long chromosome in *A. chilensis*. A similar origin for the medium-sized chromosome with a secondary constriction in *Curculigo orchioides* is now suggested. In general morphology, the karyotype of the species under examination shows an unmistakable resemblance to that of *Alstrœmeria pulehella*, except for the presence in the former of an extra pair of short chromosomes. The two pairs of short chromosomes of identical size and morphology

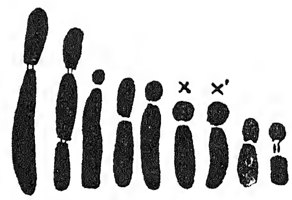

FIG. 2. Idiogram of the haploid complement × 4050

(denoted x and x') suggest that one of them is the reduplicated pair. Evidence for this suggestion would naturally lie in the behaviour of these pairs in meiosis and investigations to this end are in progress. The absence of satellites and the extremely terminal constrictions are features peculiar to the chromosomes of *Curculigo orchioides*.

Thanks are due to Dr. K. V. Srinath for guidance and criticism and to Dr. L. N. Rao for his encouragement.

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TRANSPORT OF MILK IN WARM CONDITION

THE best means of encouraging milk production in the country is to find a ready market for the liquid milk at a reasonably fair price. Chap milk can only be produced in rural areas and means must be found to transport it in a wholesome condition to the consuming centres. The usual accepted method for keeping liquid milk in good condition is chilling up to 48-50° F. Considering our climatic conditions this is a costly method as the milk generally has to be cooled to about 50° F. below the atmospheric temperature. Recently Desai, *et al.* (1946) have suggested that milk can be kept wholesome for 16 hours by keeping it at 150° F. No change in the fat percentage and acidity of milk occurs when it is stored at this temperature for 16 hours. There was also a decrease in the bacterial count at this elevated temperature as compared to cold storage (50° F.). The milk, however, acquired a cooked flavour.

Even if milk can be kept in a marketable condition at 150° F. there is not much advantage in adopting this method as the cost is not likely to be very different from the cost of refrigeration. Investigations were, therefore, conducted to see if this temperature can be further reduced to that it may be as near to the average climatic conditions (100° F.) as possible. The aim was to find the temperature at which milk could be kept fresh for a period of about 48 hours, as this will give a wide scope for its transport to distant places.

In laboratory trials 200 ml. of milk was kept in sterile conical flask after raising it to the particular temperature under study. The flasks were plugged with cotton-wool. For each series six such flasks were used and removed one by one at different intervals. Effects of keeping milk at 86·0°, 98·6°, 113·0°, 122·0°, 131·0° and 143° F. (30·0°-61·7° C.) were studied over a period of 48 hours. The results obtained are shown below.

Effect on Milk by Keeping it at Different Temperatures

Sample Number	Milk used	Acidity (% lactic)				
		Initial	4 hrs.	8 hrs.	10 hrs.	24 hrs.
I.	*Milk kept at 86° F. (30° C.)*					
	1 Buffalo	0·11	0·11	0·11	0·13	0·65 C
	2 ,,	0·12	—	—	0·50C	—
	3 ,,	0·11	0·11	0·17	—	0·70
	4 ,,	0·12	--	—	0·44	—
	5 ,,	0·12	0·12	0·15	C	—
	6 ,,	0·12	0·12	0·15	—	C
	7 Cow	0·14	0·15	0·16	—	C
	8 ,,	0·12	0·13	0·21	—	C
	9 ,,	0·12	0·13	0·17	--	C
II.	*Milk kept at 98·6° F. (37° C.)*					
	1 Buffalo	0·11	0·11	0·12	—	0·62
	2 ,,	0·12	—	—	0·39	C
	3 ,,	0·11	0·11	0·16	—	0·66 C
	4 ,,	0·12	—	—	0·45C	—
	5 ,,	0·12	0·13	0·16	—	C
	6 ,,	0·12	0·13	0·17	—	C
	7 Cow	0·14	0·15	0·17	—	C
	8 ,,	0·12	0·13	0·24	—	C
	9 ,,	0·12	0·13	0·18	—	C
III	*Milk kept at 113° F. (45° C.)*					
	1 Buffalo	0·11	0·11	0·12	—	0·26 C
	2 ,	0·12	0·12	—	0·41C	—
	3 ,,	0·11	0·11	0·13	—	0·42 C
	4 ,	0·12	—	—	0·29	— C
	5 ,	0·12	0·12	0·20	—	C
	6 ,,	0·12	0·12	0·16	—	C
	7 Cow	0·14	0·16	0·17	—	C
	8 ,,	0·12	0·13	0·27	—	C
	9 ,,	0·12	0·14	0·19	—	C
		Initial	6 hrs.	24 hrs.	30 hrs.	48 hrs.
IV	*Milk kept at 122° F. (50° C)*					
	1 Buffalo	0·12	0·13	0·14	C	—
	2 ,	0·13	0·13	0·13	C	—
	3 ,	0·13	0·13	0·13	0·15	0·36
	4 ,,	0·13	0·13	0·36C	—	—
	5 Cow	0·14	0·14	0·14	0·14	C
	6 ,,	0·13	0·13	0·13	C	—
	7 ,,	0·13	0·13	0·13	C	—
	8 ,,	0·13	0·13	C		
V	*Milk kept at 131° F. (55° C.)*					
	1 Buffalo	0·12	0·12	0·13	0·13	0·13
	2 ,,	0·13	0·14	0·14	0·14	0·14
	3 ,,	0·13	0·13	0·13	0·14	0·14
	4 ,,	0·13	0·13	0·13	0·13	0·13
	5 Cow	0·14	0·14	0·14	0·14	0·14
	6 ,,	0·13	0·13	0·14	0·14	0·14
	7 ,,	0·13	0·13	0·13	0·13	0·13
	8 ,,	0·13	0·13	0·13	0·13	0·13
VI	*Milk kept at 143° F. (61·7° C.)*					
	1 Buffalo	0·12	0·12	0·12	0·12	0·13
	2 ,,	0·13	0·14	0·14	0·14	0·14
	3 ,,	0·13	0·13	0·13	0·13	0·13
	4 ,,	0·13	0·13	0·14	0·13	0·13
	5 Cow	0·14	0·15	0·15	0·15	C
	6 ,,	0·13	0·13	0·13	0·13	0·13
	7 ,,	0·13	0·13	00·13	0·13	0·13
	8 ,,	0·13	0·13	0·13	0·14	0·13

C = Curdled.

At temperatures up to 113° F. almost all the samples curdled within 24 hours. At 131°F. and 143° F., both cow and buffalo milk kept fairly well even up to 48 hours. There was little change in the acidity of milk.

The above studies were further extended using 2 litres of milk in closed tinned brass vessels instead of glass flasks. At 145° F. ± 4° F. it was found that about 85 per cent. of buffalo milk and 70 per cent. of cow milk samples curdled within 48 hours. Studies carried out at 130° ± 4° F., on the other hand, gave very promising results. In nine trials none of the samples curdled. There was no decrease in volume and no skin formation took place after keeping the samples for 48 hours. The samples had sweet flavour. The fat percentage of milk did not show any change.

The above studies are being further extended with larger quantities of milk and it seems reasonable to expect that when dealing with greater bulk of milk it will be possible to reduce the temperature below 130° F. ± 4° F. and thus provide a simple and economic method for the transport of milk from rural to urban centres.

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BACTERIAL LEAF-SPOT ON ARUM

DURING July 1944 in almost all the vegetable-growing areas of Nagpur, leaves of arum (*Colocasia antiquorum* Schott) were found spotted all over the surface, which on examination, proved to be due to some bacteria. As far as known to the author, the bacterial leaf-spot disease of arum has not so far been reported from anywhere else. A few bacterial diseases have been recorded on different species of *Colocasia* and *Alocasia*. Jones[3] (1901) reported that *Bacillus carotovorus* Jones [now according to International rules changed to *Bacterium aroideæ* (Towns) Stapp.], caused a rapidly progressing soft wet rot of roots, rhizomes, fruits and fleshy stems of vegetables and other plants; *Alocasia macrorrhiza* and *Colocasia esculenta* were also attacked by this organism. Ciferri[1] (1927) states that inoculation experiments with a strain of *Bacillus carotovorus* (*Bacterium aroideæ*), isolated from the rotted rhizomes of *Xanthosoma sagitifolium*, gave positive results on the original host as well as on *Colocasia antiquorum*, *Alocasia macrorrhiza*, etc. In 1936, it has been reported from Hawaii that *Colocasia esculenta* is subject to two major corm rots, one a soft rot associated with an unidentified *Pythium* and with *Phytophthora colocasia*, frequently accompanied in a secondary capacity by *Bacillus carotovorus* (= *Bacterium aroideæ*). All attempts to reproduce the typical features of the rot, as observed in field by Parris[4] (1936), gave negative results, and the development of the disease is believed to be due to the combined action of either or both the above-mentioned weakly parasitic Phycomycetes and unfavourable soil conditions.

The bacterial leaf-spot disease has been found to occur on *Colocasia antiquorum* Schott, and *Alocasia indica* Schott, the leaves and rhizomes of which are extensively used as vegetables in the Central Provinces and Berar. The disease has been found to cause considerable loss as the leaves become unfit for human consumption and the yield of the corms are appreciably reduced.

The first symptom of the disease is the occurrence of minute, round to oval, dark sage-green coloured spots which are roughly arranged in streaks all over the upper surface. During rainy season these spots are mostly localised on the upper surface of the leaves, only a few scattered ones on the lower side, but during winter they are equally prominent on both the sides. The spots on the upper surface of the leaves are dark sage-green in colour while on the lower surface as eucalyptus green[2] but they are similar in their nature of growth and size. Corresponding yellowing or marking on the opposite sides are not found in either case. Within three to four weeks these spots become larger in size, varying from 0·5 mm. to 1 cm. in diameter, and invariably coalesce later to form larger patches. With the advance of the disease the colour changes to light yellow and then light brown. Such affected leaves lose their lustre and drying starts from the periphery towards the centre. After a few days the leaves die. Excess of soil and atmospheric humidity are most favourable for the spread of the disease. Younger leaves were more susceptible to the disease than the older ones.

The pathogen was isolated from the infected leaves and pure cultures were maintained on glucose-agar tubes where the growth appeared within 24 hours. By inoculating, the disease could be artificially reproduced in its natural conditions. The infection could be induced on the lower as well as on the upper side of the leaves. The disease appeared within 24 hours on the lower side and after 48 hours on the upper side during rainy months and after 3 to 4 days during winter season. On reisolation the same organism was always obtained. It was observed that primary symptoms appeared when small quantities of the organism were placed on healthy leaves while by placing larger amounts the secondary effects were produced. In cross-sections the bacterium was noticed in the parenchymatous tissues and in the palisade cells.

On glucose agar medium the organism formed round, smooth and depressed colonies, varying from 0·5 mm. to 4 mm. in diameter. The bacterium is motile, highly refractive and rod-shaped, varying in its size from 1·33 to 3·13 μ in length and 0·66 to 1·33 μ in breadth, the average measurements being 2·13 μ × 0·93 μ. Growth on agar-agar streaks is smooth, soft and of spreading type with slimy surface having fine ridges. The organism has so far not been identified.

Further work is in progress.

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REVIEWS

METALS AND ALLOYS*

THE following remarks culled from the opening pages of the two books under review indicate the need which they endeavour to fill, in different ways, for a presentation of the subject of metallurgy from the newer points of view :

"X-ray metallography is proving itself to be an essential tool in metallurgical research. It is taking its place beside the classical thermal and microscopical methods which have proved to be so valuable to the study of metals and alloys. It supplements these methods rather than replaces them, the combination of all being the ideal to aim at. X-ray analysis has almost been entirely developed by physicists who have been handicapped by their lack of metallurgical experience. The metallurgist's wide knowledge of the behaviour and characteristics of alloys is beyond the reach of the physicist, and he must look to his colleagues to appreciate the uses to which the new tool he has developed can be put." * * *

"The scientific study of the structure of alloys was first developed by the physical chemist and by the metallurgist. It is now tending to become the province of the physicist and the mathematician. The student who is interested in this important subject is often inclined to feel that, until he has specialised in all these branches, he cannot hope to understand its recent developments." * * *

The smaller volume by Benyon is intended as an introduction to the modern physico-chemical theories of the structure of alloys. Its aim is to present the "subject-matter in such a way that it will be of direct use to practising and student metallurgists and to similar groups of chemists and physicists who are becoming increasingly concerned with metals and alloys; as also to convey to students of metallurgy, chemistry and physics, a broad outline of the contributions made within recent years towards the solving of what were some of the bewildering problems of the science of alloys". Considered from the standpoint of these aims, the book can claim to have achieved a considerable measure of success and may be heartily commended.

Dr. Taylor's volume is a more ambitious production. It is intended both as a systematic treatise and as a book of reference regarding the use of X-ray analysis as a tool in metallurgical research, and covers the field indicated by these aims in a systematic and thorough fashion. About a third of the book is devoted to the presentation of the fundamental theory and experimental technique of crystal structure analysis by the X-ray method. The eighth, ninth and tenth chapters of the book deal with the study by X-ray methods of the metallographically important topics of thermal equilibrium diagrams, measurement of grain size and grain orientation. Two chapters follow, dealing respectively with the application of X-rays to the study of refracting materials and with radiography and the micro-radiograph. No less than seventy pages are devoted to an Appendix containing numerous tables and data useful to those engaged in X-ray studies and metallographic research. The book will be appreciated by all X-ray workers and metallurgists, and may be read with profit also by those who are not specialists in these fields, but are interested generally in the technical achievements of modern science.

C. V. RAMAN.

* *The Physical Structure of Alloys.* By C. E. Benyon. 126 Pages octavo; London · Edward Arnold & Co., 1945. Price 6/6 net.

* *An Introduction to X-Ray Metallography* By A. Taylor, with a Foreword by Sir Lawrence Bragg. 400 Pages Royal octavo; London : Chapman & Hall, 1945. Price 36/- net.

The Diffraction of X-Rays and Electrons by Free Molecules. By M. H. Pirenne. (Cambridge University Press), 1946. Pp. 1-160 + xii. Price 12*sh.* 6*d.*

X-ray and electron diffraction studies have, in recent years, been developed into a powerful tool for the elucidation of molecular structure. Although the theoretical basis of the diffraction of X-rays by atoms and molecules was developed by Debye as early as 1915, it required several refinements in the theory before the experimental results could be utilised for determining the structure of molecules. The most important of these is the realisation that the incoherent Compton scattering forms a significant part of the total scattering. The theoretical ideas have now been developed to such an extent that it has been possible to detect the influence of thermal atomic vibrations on the diffraction curve of a molecule, at least in one instance. Another notable use of the diffraction of X-rays is in the study of the liquid state, which has resulted in the discovery of the quasi-crystalline nature of liquids in general.

The book under review deals with these and various other aspects of the subject in a brief and highly stimulating manner. As Prof. Debye remarks in his preface to the book, "It contains all essential information about a subject intimately connected with our understanding of molecular structure". For a book of only 160 pages, 'the large variety of topics discussed must be considered remarkable. This has been achieved by reducing mathematical details to the minimum; but this has not resulted in a lack of rigour or precision in the treatment. The chapter on experimental methods will provide valuable hints for the construction and use of the apparatus required in those studies. A complete bibliography is also included of papers published on X-ray diffraction by gases

and also of all determinations of molecular structure made by this method. The book will certainly prove to be a highly useful companion to all those engaged in research work on X-ray and electron diffraction.

G. N. RAMACHANDRAN.

The Indian Textile Industry (1945-46) Annual (Messrs. Gandhi & Co., Publishers, Jan Mansion, Fort, Bombay), is one of its interesting annual series brought out by Mr. M. P. Gandhi, its Founder-Editor.

The main features of the *Annual* include a well presented review of the industry's progress during the year 1945-46 from all aspects, the ppresent financial and economic position of the industry and its future outlook. It also gives as usual an overall picture of the industry with authoritative and up-to-date statistical tables and the scope it provides for further planned development of the industry under a well-guided national policy.

The volume also deals critically with the various legislative measures on the anvil of the Government of India for improving the conditions of labour estimated to cost as much as twelve rupees per month per operative. While recognising the necessity of improving the lot of labour it cautions the Government against forcing the pace of reforms beyond a limit in these fluid times.

The editor also draws pointed attention to the growing competition of rayon—cotton's chief rival—to the cotton textile industry. Far from looking on rayon with a hostile eye the industry could do well to adapt itself to an extended use of this synthetic material thereby making available a larger range of textiles to the common man. He advocates the abolition of the excise duty on imported raw cotton as he believes it imposes a needless handicap on the competing capacity of the industry as against foreign manufacturers. While one may agree with this as an expedient, its wisdom as a permanent policy is to be doubted, as it operates as a deterrant to cultivators of long-stapled varieties of raw cotton at home with our present uneconomic methods of cultivation.

The book concludes with three appendices, one relating to raw cotton, its cultivation, export, import and consumption in the country; the second, regarding the present position of the handloom industry and its future in relation to mill industry; and the third gives a complete up-to-date list of cotton mills working in India. The chapter on handloom industry is very illuminating and provides interesting reading. The author has freely drawn upon official views and reports in order to complete the picture of the subject.

An important omission as it strikes one after going through the volume, is its failure to take into account the necessity and urgent importance of manufacture of textile machinery and the need for the active encouragement of other complementary and ancillary industries. In this respect the present state of affairs is a sad commentary on the lack of interest displayed by the textile industry and the apathy shown by the Government. India appears to be blissfully content with producing cotton and converting it into textiles with little or no thought bestowed on the manufacture of machinery and necessary essential stores. The author would do well to stress this important aspect of the industry by giving necessary information and statistical data. If even the existing sources and facilities in the country were to be fully harnessed in a well planned and co-ordinated effort much could be done in the matter of supply of urgently needed requirements of the industry and in the matter of reconditioning the already overworked plant.

On the whole, the volume should prove very useful and interesting to every one interested in the textile industry both as an annual refresher and as a handy-book of reference.

B. G. R.

WATER TRANSPORT*

FROM the earliest times man has devised a variety of means of transport over water beginning with the simple log of wood which helped him float down the stream near his habitation. The subsequent discovery of means of propulsion by the use of logs whilst astride a floating log led to the use of paddles and oars. Combination of floats led to rafts, catamarans and such composite gear, while the single log gave place to floating pots, baskets, bark canoes, coracles and the dug-outs. These variations, steadily modified and improved upon by different peoples in different parts of the world, provide the large number of types of water transport we now encounter. Some of these have made little improvement on the primitive pattern while others evolved in different directions in accordance with the requirements and conditions of life of their users. The source of raw material for building them has also profoundly influenced the modifications. It is often difficult to assess the relationship between one type and another because, as judged by the present-day craft, the story is not continuous but one full of gaps. The object of the author has been to set forth in detail the numerous types of water transport perfected by man from the earliest times till the advent of the Sailing Boat and the subsequent introduction of steam and internal combustion engines and to indicate the evolutionary changes which have taken place in these Craft. The subject is of great interest as it throws much light on the wanderings of people in ancient times.

In the accomplishment of this difficult task of compiling information on the Craft now in use and connecting it with the notes and observations of numerous historians and travellers, Hornell's first-hand knowledge of most of the modern Craft in use has been invaluable. He spent some years in Ceylon in charge of Pearl

* *Water Transport: Origins and Early Evolution.* By James Hornell. Pp. xv + 1–307; Pls. I–XLV, I Map and 69 Text Illustrations. Cambridge University Press, 1946. 30 *sh.* net.

Fishing operations in the Gulf of Manaar, an industry which attracts many groups of maritime fishermen with the most diverse craft and gear. A long period of Fishery Administration in the Province of Madras which followed enabled him to observe the fishing vessels in use in different parts of India. He undertook long journeys in Malaya, Indonesia and Japan, all most fruitful to the object of his study. He has been able to observe most of the Craft he describes in their work-a-day occupations by people belonging to different stages of civilization and material culture. This fortunate combination of his interests and the opportunities offered by his occupation has given this very readable and illuminating account of river, lake and sea-craft—a work which is the result not of armchair scholarship but of extensive and accurate field observation.

Hornell has arranged his material in three main sections devoted to three broad types into which the Craft may be classified. The first of these deals with floats, rafts and kindred craft. This includes the most primitive agencies of water transport; swimming and riding floats of various types are to be seen in use even at the present day as, for example, the buoyant blocks of wood used by fishermen in the Lower Kaveri and the Godavari, and the round-bottomed earthenware jars or *Pallachatties* used by the Sind fishermen in their pursuit of Hilsa. Gourds are used in many countries in the place of pots. Another variant is the inflated skin float which is of great antiquity, being depicted in sculptures from Nimrud and Ninevah and, in fact, associated with most subsequent civilizations of the Mediterranean region. An improvement of the simple float is that which is ridden astride, several variations of which occur. Another line of evolution has been the combination of floats as rafts, either of the earthenware pots or of inflated skins; Chatty rafts of various kinds are known from different parts of India. In a different category are the reed rafts and reed Canoes of worldwide distribution but among which the graceful reed balsas of Lake Titicaca in S. America form a highly specialized type. Among the first group, the most specialized are no doubt the log rafts and catamarans so peculiar to the surf-beaten Coromandel Coast of India showing great variations in structure chiefly to suit the particular type of fishing for which they are employed. Sea rafts of various patterns are found all along the Indo-Pacific extending to S. America. Describing these various modifications leading up to the construction of the Chinese Sampans, Hornell concludes that Sampans and Junks are descendants of shaped and specialized rafts rather than of Canoes.

Skin boats like coracles, curraghs, kayaks and their kin are dealt with in the second section; these boats, which have the common characteristic of a light framework and covering by hide or some cloth, are widely yet discontinuously distributed in Asia, Europe and North America while none is encountered in Africa; its occurrence in S. America (the *Pelota* of La Plata) is probably by a recent introduction. Indian coracles are different in construction from the other varieties and are found only on the Kaveri, the Thungabhadra and the Kistna. Once we pass the Deccan they reappear only in Tibet; they are absent from Persia and Afghanistan while in Eastern Bengal, their place is taken by the earthenware *tigari* which serves a similar purpose. In middle China and Japan it has modified into wooden tub-boats; a modified basket-boat is met with in Indo-China. The true coracle again reappears in Iraq. After detailed accounts of these, Hornell describes at some length, the British coracles and Irish curraghs giving notes on their historical and literary associations and folklore. This is followed by notes on the American coracles. The most specialized skin boats in existence are those used by the Eskimos; the roomy *Umiak* which is a large open boat, deep-sided and capable of carrying passengers and cargo, and the light, canoe-like *Kayak* which is mostly constructed to take a single person. Describing these in detail, the author deals with the origin of the skin boats and the evidences which are brought forward are of great interest. Discarding the possibility of a single theory to explain the origin and evolution of all skin boats, Hornell considers that while it is essential to recognise at least four different types, *viz.*, the coracle, the curragh, the *Umiak* and the *Kayak*, it is possible that the first three have a common denominator. The coracle being worldwide in distribution (Africa excepted) and, notwithstanding the possibility of independent invention in different localities as probably shown by the S. American *Pelota*, originated very early in man's cultural history. It is indicated that Central Asia was the probable area where the coracle originated and flourished under conditions where timber was in short supply but was slowly displaced by larger and heavier wooden craft in places like India with an abundance of fine timber.

The Bark Canoes, Dug-outs and Plank-built Craft are dealt with in the third section. In a discussion on the genetic relations of the Bark Canoe, the Dug-outs and the Plank-built boats it is pointed out that, though both the Clinker and Carvel types of plank-built craft are ultimately derived from the dug-out canoe, the latter type possibly represents only an intermediate stage in the evolution of the plank-built boats. Hornell develops this idea by indicating that the bark canoe is possibly the most ancient and the dug-out possibly evolved only as an improvement on the former, some of the modern dug-outs like the Malabar canoe even presenting vestigial relics of the bark canoe framework in the form of rib-like inner ridges. In tracing the evolution of the plank-built craft the stages are (*a*) the trough-shaped bark canoes, (*b*) sharp-ended bark canoes, (*c*) dug-out canoes and finally (*d*) the plank-built canoes. The modifications adopted in the change from the dug-out to the Carvel-built ship are worked out and a similar account is drawn up for the evolution of the Clinker-built fishing lugger. Constructional parallels in Scandinavian and Oceanic boats are traced and chapters dealing with the sailing ships of Ancient Egypt, the development of Arab ship design, the various types of boats found on the Ganges and the outrigger devices are included.

The last mentioned is of particular interest to India owing to the prevalence of outrigger canoes on the West Coast of India with a probable centre of distribution in the Ratnagiri and Konkan Coasts where they are often operated with Rampani nets. Outrigger devices are of two kinds, either the double outrigger where there is one accessory float on each side connected to the boat by balancing booms or the second type where there is only one outrigger and a pair of booms connected only to one side. The double outrigger is found in the Philippines, Indonesian Islands, Malaya, Madagascar and the East Coast of Africa, whereas the single outrigger occurs in India, Ceylon and in the large number of Pacific Islands. Contrary to the popular belief Hornell points out that the most primitive of the two is the double outrigger canoe, the single one having been a special adaptation to suit sailing in the open and rough seas. The last chapter is devoted to the numerous socio-religious and superstitious practices connected with the launching of boats and the significance of Oculi and other marks in boats in certain areas and their possible causes for absence from others. In addition to the numerous plates at the end of the book and text-figures mostly from the author's pen, there is an excellent bibliography and a map showing the distribution of the principal types of primitive water-craft.

Both the author and the Cambridge University Press deserve great praise for the publication of such a well-got-up and documented book which will be of equal interest to the general reader and to the serious student of that ill-defined borderland between history and anthropology.

N. K. PANIKKAR.

SCIENCE NOTES AND NEWS

PROF. C. K. INGOLD, F.R.S., has been awarded the Davy Medal of the Royal Society.

ELMER DREW MERRILL, Sc.D., LL.D., Arnold Professor of Botany at Harvard University, formerly Director, Bureau of Science, Manila, Dean, College of Agriculture, University of California, Director, New York Botanical Garden, Administrator of Botanical Collections, Harvard University, and Director, Arnold Arboretum, was seventy years old on October 13, 1946. At the occasion of the birthday anniversary of the *American Linnaeus* a special dedicatory number has been issued of the *Journal of the Arnold Arboretum*, edited by A. C. SMITH, to which colleagues all over the world have contributed. Early in October a special double issue of *Chronica Botanica*, edited by Frans Verdoorn, was published in honour of Dr. MERRILL. This 266-page number, entitled *Merrilleana*, consists of an authorized collection of reprints of DR. MERRILL's principal general writings, as well as a chronological biography, and bibliography.

RAI BAHADUR A. N. KHOSLA, I.S.E., Consulting Engineer with the Government of India, and Chairman, Central Waterways, Irrigation and Navigation Commission, who represented India in the Executive Committee of the International Commission on High Dams, held recently in France, was elected one of their Vice-Presidents.

At the instance of the Government of India Mr. Khosla extended an invitation to the Executive Committee of the International Commission on High Dams to hold their next (1947) session in India. Since they had already accepted the invitations from Holland to hold their session in 1947 and from Sweden in 1948, the Committee is reported to have accepted in principle the invitation to hold their 1950 session in India.

It is expected that an International Commission on Irrigation and Canals will, when formed, choose to establish its headquarters in India. Mr. Khosla who attended the International Commission on High Dams on behalf of the Government, discussed this problem with the members of the Executive Committee of the International Commission on High Dams as also with the Commissioner of the U.S. Bureau of Reclamation in Washington, U.S.A., who have extended their strong support to this proposal.

Soap manufacturers of South India have formed themselves into an Association under the name of *"South India Soap Makers' Association"* with Registered Office at Calicut, at the first General Meeting held in Calicut on the 3rd November 1946, under the presidency of Rao Sahib A. K. Menon.

The aims and objects of the Association are to protect the soap industry in general, to work for the growth and development of the industry, to educate the public in the use of soap, to standardise the quality, to take joint action in the matter of legislation, and do such other things in the interests of the organised industry.

ERRATA

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Page 306, Note on "Synthesis of Folic Acid", para 3, line 4: *for* "2, 4, 5-triamino-6-hydroxy pyridine" *read* "2, 4, 5-triamino-6-hydroxy pyrimidine". Para 6, line 13: *for* "was found to contain" *read* "were found to contain".

Page 318, Note entitled "Nitrogenous Fertilisers in Relation to the Keeping Quality of Potatoes": In the table, the data under Manured and Unmanured Plots, *read* "Unmanured" *for* "Manured" and *vice versa*.

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